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The Oldest American Aeronautical Magazine

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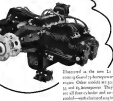

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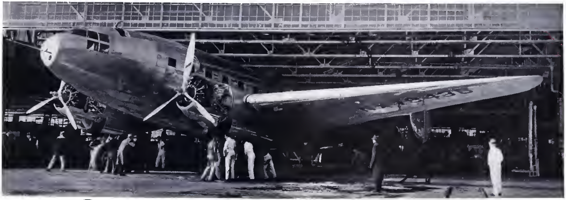

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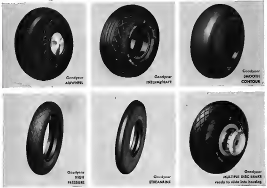

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MARCH 1940
REGULAR EDITION

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A McGRAW-HILL PUBLICATION

Flashes

Picked Up Along Editorial Airways

» ANOTHER YOUNG MAN WAS TAKEN from the ranks of aviation executives last month. A vice-president of the Curtiss-Wright Corporation at the age of 38, Robert P. Farnsworth died February 17, in the Harkness Pavilion of New York's Columbia Presbyterian Medical Center, following an illness of only two weeks. Bob had been with Curtiss-Wright for ten years. His first job in the corporation was in the Washington office where he signed on in April, 1930. In 1932 he was transferred to the export division and, in connection with this assignment, he traveled extensively in Europe and in the Near East. In 1932 he represented the corporation in Paris. Prior to his connection with Curtiss-Wright he passed a year in training with the U. S. Army Air Corps at Brooks and Kelly Fields. Born in Plattsburg, N. Y., he attended the local high school and Blair Academy, Blairstown, N. J., before entering Williams College in 1921. He was graduated four years later, having been elected to Phi Beta Kappa. His first position following graduation was with a firm in Wall Street, which he left to join the Air Corps.

Surviving are Mrs. Farnsworth, the former Sigrid Malmstrom, whom he married in Stockholm in 1932, two sons, Peter and Michale; and a brother, Charles F. Farnsworth of Montclair.

» IT IS A POPULAR PASTIME to take cracks at Congressmen and very frequently they are not undeserved, but it is only fair to call attention to those instances in which our lawmakers give evidence of an accurate appraisal of some current problem. An excellent example is found in Congressman Woodrum's report on the Independent Offices Appropriation Bill for 1941 which provides the wherewithal for the National Advisory Committee for Aeronautics. Quoting from the section on the N.A.C.A.:

"In the present disturbed condition of world affairs the importance of accelerating aeronautical progress cannot be overemphasized. Scientific laboratory research is the chief foundation on which aeronautical progress is based. The Army, the Navy, and the Civil Aeronautics Authority are all represented on the N.A.C.A. and they depend upon that scientific organization to coordinate and to meet the research needs of aviation and to provide constantly the new knowledge necessary to keep the United States at least abreast of other nations in the development of aeronautics for both military and commercial progress.

"The Army and the Navy will expend during the coming year approximately $300,000,000 for new aircraft. To safeguard this expenditure the N.A.C.A. must provide solutions to many important technical problems for the military services * * *".

These excerpts give ample evidence of the Congressional grasp of an important element in the progress of commercial aviation as well as national defense.

Robert P. Farnsworth, late vice president of the Curtiss-Wright Corporation

» BUT CONGRESSMEN MUST BE EDUCATED sometimes and our hats are off to Gill Robb Wilson and his coworkers in the new N.A.A. for the part they took in convincing Congress that $1,000,000 of the C.A.A. appropriation be restored after it had been sliced off in the shuffle. This particular million had been earmarked for a new airway and was much needed. This piece of work is a most promising indication of the type of leadership which has at last found its

IT PAYS TO FLY

way into the N A A A few more jobs like this and many will be forced to revise our beliefs in the effectiveness of N A A

» THE HIGH COST OF AIRPLANES has been in some part due to lack of standardization of parts, materials and equipment going into them Many a plane manufacturer has had to pay through the nose because the fellow who sold him his materials has had to carry an unreasonably large inventory of different sizes of nuts, bolts, tubing, and light alloy shapes or a dozen assorted widths of safety belting And as the industry expanded, this condition became worse instead of better A short time ago the Elastic Stop Nut Corporation appealed to the manufacturers for cooperation in standardization of nut sizes and invited the Eastern manufacturers to visit their plant and see at first hand the supplier's side of the problem That started an organization for standardization Then followed meetings at Curtiss-Wright (Buffalo), Martin, and Grumman, Vought-Sikorsky and Republic. Fifteen companies are participating through their leading engineers, and a movement is now afoot to prepare a standards program for final adoption by the S A E The committee is to be congratulated on the steps they have taken to place aircraft manufacturing on a more economical and efficient basis

» WHY TRAVEL BY RAIL when the airlines get you there four times as fast, with at least equal safety, and probably in the future at reduced fares This brilliant performance plus the cooperation and encouragement of the C.A A should mark the beginning of the air travel boom we have been waiting for But with all this increased activity in the offing there is an even greater need for eternal operating vigilance Yielding to the inevitable temptation of slipshod maintenance or loose operating practices to accommodate the expected peaks will result in serious setbacks

» DON'T BE ALARMED if you were a speaker at the recent Institute meetings and noticed an attractive young lady making sketches while you spoke. The sketcher was Mrs Elizabeth P Korn, AVIATION's artist, who has recently come to this country from Europe where her talents are well known Unfortunately Mrs Korn was unable to catch everyone at the Institute meetings and we apologize to those who were omitted But there will be other opportunities and your turn may come next. If you are among those present we will gladly send you the original sketch on request

» SOME of our readers may have noticed an article in *American Aviation*, issue of February 1, 1940, referring to a suit filed by us against them This article and another published in *American Aviation* over a year ago contained many misstatements. However, we do not feel that we should consume space which rightly belongs to our readers in order to air our private disagreements with other publishers We believe that it is sufficient for us to point out that the title "AVIATION" is a registered trade mark and its first use dates back to 1916. That in 1937, when the first announcement of the contemplated publication of *American Aviation* was issued, we protested against the use of the title upon the advice of competent attorneys that it was in legal conflict with ours, and it was only after a year of attempts to iron out the matter amicably with no success and the accumulation of written evidence of confusion in the minds of many of our readers and advertisers, and inconveniences and losses to some of them because of the similarity of titles, that we felt compelled to start suit to right what we considered a definite wrong Contrary to any implication which the last article in *American Aviation* may have created, the case is still pending in court and has not been finally adjudicated

"McGuire's Lobbying to Save His Re-feathering Appropriation!"

Side Slips

By
ROBERT OSBORN

» A New Orleans paper shows a picture of a captured pelican which had been forced down by ice on its wings during this winter's spell of very cold weather in the south. In the past, whenever anything new has been developed for the airplane, ornithologists have always claimed that, shucks, birds had that feature all worked out long ago,—ailerons, streamlining, retractable and amphibious landing gears, wings aspect ratios to suit the flying characteristics of the type of bird, formation flying,—and so on.

All right, you bird fanciers, how about de-icers?

» The way of the inventor seems to be as hard as that of the proverbial transgressor. According to a *New York Herald-Tribune* article, Harold Lentz, who runs a seaplane school on the Hackensack River in New Jersey, is completely tired of his own ingenuity. When the river froze over recently he added extra wheels on his seaplane and operated from a marsh near his base. Three times so far he has had to explain to radio car policemen that he is not a spy photographing nearby radio towers, and that he has not cracked up in the marsh and in need of rescuing. So Mr Lentz has written to N. J. State Aviation Director Wilson asking that all nearby police departments be notified that he is just another fixed base operator trying to get along.

» "Compared with the old days when you had to wear three pairs of boots, three pairs of gloves, a flying suit, a fur-lined helmet, a face mask and goggles to keep from freezing to death in an open plane, 'flying today is an absolute cinch,' Blanche Noyes of Washington, one of the nation's leading aviatresses, said Wednesday between sessions of the National Aeronautic Association at The Roosevelt.

"'Now all you have to do is climb in a plane and press a button. You can wear your best bib and tucker and arrive at your destination with every curl on your head in place. When I think of the way we had to crank that propeller, of all the clothes we had to wear, of the way our hair and makeup looked when we reached important airports'." (From *The New Orleans Times Picayune*)

You have something there, Mrs. Noyes! When the self starter, enclosed bodies, easier driving and greater reliability entered the automobile field, so that women could handle a car as easily as the men, the industry really got into production,—and it is easy to see that just about the same thing is taking place in aviation.

We remember just a few years ago that we happened to be in Chicago when the Ford Reliability Tourers, including one lady pilot, arrived at the airport. Always the gent, we helped the lady pilot with her baggage from her plane to the hotel bus,—but we had no idea what a chore that lugging of baggage was going to be. Her 'Overnight Bag" was full of tools, including a welding torch and an anvil we suspected, and the parachute case contained spare cylinders, rings, connecting rods and spark plugs. Furthermore, she had made good use of all of this equipment in making repairs, by herself, after the two forced landings she had during the Tour.

» An article on aerial cameras as used in warfare, also from the *Herald Tribune*, states that they have now been so highly developed that they can take clear photographs through darkness, cloud banks, and dense fog. Furthermore they can locate mine fields accurately and can take stereoscopic pictures which cut through the maze of camouflage showing the topography of the land accurately.

It's all very well for these amazing

improvements in photography to be used in warfare, where anything goes, but there ought to be a law passed immediately to prevent these devices from ever being adapted for use with "candid" cameras.

"ITALIAN DISTANCE FLYERS LAND 3,000 MILES SHORT"

(Headline on A. P. Dispatch)

Strangely enough, we think that this casual headline is another good indication of the remarkable progress which has been made in aviation. The Italian airplane which was being used in an attempt to set a world's distance record had covered 4,400 miles, and therefore to be forced down by a fuel leak 3,000 miles short of the goal is no disgrace to any airplane nowadays. However, it wasn't so very long ago that it took a *very good* airplane to be forced down 300 miles short of an intended distance record.

International News

BRITISH ACES *in the Making*

Training 25,000 airmen a year for the R.A.F. is one of Canada's war jobs for the British Government. Empire-Training-Plan details are presented here.

By James Montagnes

ON airfields and in training schools throughout Canada the British Empire has started on the British Commonwealth Air Training Plan, by which 25,000 pilots, air gunners and air observers will be turned out every year for at least three years and if necessary for a longer period should the war last beyond that time From coast to coast young Canadians are being rushed through a 26 week course which turns them from civilians to members of bomber and fighter airplane crews

Since the outbreak of war plans which have been nurtured on paper for the past year have matured into actuality Air missions from Great Britain, New Zealand, Australia and Canada have met at Ottawa and signed agreements. The vast complicated machinery to get the largest air training scheme in history into operation has been set up, and now as the snow leaves most of Canada's airfields the first recruits have started their training

The training of 25,000 fighting airmen in the Dominion, with the bulk of them being recruited in Canada, is considered the Dominion's most important, though not only, military contribution in this war Canadians think it only fitting that Canada should have been picked for the task since they contributed about one-third of the airmen who flew in the British forces in the first World War From strategic angles Canada was chosen because of its vast interior inaccessibility to European bombers, making possible air training in the greatest security

The British Commonwealth Training Plan has not stopped air training in Great Britain, Australia or New Zealand In each of these countries training continues trainees only going to Canada to complete their advanced instruction before qualifying for actual combat work in any section of the British Empire or any war zone where they may be needed. The Empire plans to be as powerful in the air as it is on the sea.

Training is not confined to any one section of Canada, but from the Atlantic to the Pacific, with the schools and fields being concentrated near the larger cities With most aircraft factories and maintenance shops situated in Quebec and Ontario, with Canada's West Point of the air at Trenton, Ontario, most of the schools will be located in eastern Canada. Provincial and municipal governments have turned over vast technical schools and institutional buildings to the Dominion government for use as air training schools

There is no conscription in Canada The Royal Canadian Air Force has

(*Turn to page 107*)

International News

Link Trainers are used extensively

Three Lions

Four types of training planes are now in use

International News

Three men who laid ground work for Canadian training L to R Air Vice Marshal G M Croil, Chief of Canadian Air Staff the late Lord Tweedsmuir Governor General of Canada; Wing Commander R J Grant.

Home-Clean AIRPORTS

People who ride on airlines pay a premium for cleanliness and comfort such as they get at home or in the best hotels. Sooner or later ground facilities must improve to equal those provided aboard the airliners.*

AIRLINE PASSENGERS are undoubtedly the most exacting group of travelers in the country. They are paying a premium rate for the finest travel service that exists. To meet their high requirements for safety, comfort and speed we have provided them with luxurious air travel that is unequalled by any other form of travel. Our airlines spend considerable sums for appointments, for hostess service, for hot meals served aloft and for the many other items that we provide to make our passengers comfortable.

Yet at the end of the trip when an air traveler steps from the plane he is often forced to enter an air terminal building where conditions are far from satisfactory. The passenger whom we have surrounded with luxury and super-service in the air may have to spend his time between planes in a dirty, noisy, crowded terminal building.

Conditions that exist at a great number of airports are apparent to all of us in the industry and each of us is trying to improve them as rapidly as possible. There is no solution that can be offered that will by any one means cure these conditions. They are matters that require constant individual handling on the part of everyone in the business. Our transportation industry has much work to do in aiding and cooperating with the municipalities that provide our airports and terminal buildings.

The objectives of the municipalities and of the transport carriers are two, and these very often seriously conflict. One objective should be to make the airport attractive to the general public and to sightseers, affording them parking place, an opportunity to see the planes and the operations conducted, and a place where an inexpensive meal may be purchased. The second objective, particularly important to the transport carriers, is, while realizing the first objective, to make private, highclass waiting room, ticketing and restaurant facilities available to air line passengers. The achieving of the first objective developa new passengers. Achieving tha second objective is most certainly necessary to retain the passengers we now have.

Transportation by air compared to any other form of transportation is a premium means of travel. The cost of air transportation is, and should be, higher than most other forms. The passenger has a right to expect in return for that higher cost not only speed but greater comfort, greater cleanliness and better handling in general when he travels by air. This requires a standard of airport equipment and operation, including the depot facilities themselves, porter service and restaurant, far superior to the ordinary type of facility that is maintained for ground transportation. At the present time, because of the physical size of the airplane, air travelers are normally congregated in smaller groups than they are in rail or bus travel, for instance. In the airplanes there is, however, less opportunity for private quarters, while at the same time we have among air travelers a large percentage of people who desire and can pay for privacy and service. This imposes upon the air lines an obligation to provide a high degree of personalized service on the ground both in facilities and in the personnel involved. Space in the airplanes is at a premium and the passenger naturally expects more in the way of completeness of service at terminals and intermediate stops.

THE typical railroad station has come to be regarded very similar to a public street, lined with shops, stores, et cetera, through which passengers walk to and from the trains. Such fixtures as brass cuspidors, noise, smoky ceiling, impossible-to-understand announcers, and hangers-on are standard equipment. A good airport terminal building, while it must contain all the conveniences of a good railroad station, must certainly avoid incorporating the bad features of the average railway terminal and must make provision for comfort, style, privacy, and quiet, efficient service.

To mention some of the things that all airports should contain, it is apparent that in addition to attractive *public* waiting room and rest rooms, separate facilities for passengers, not available to the general public, should be provided. It will always be difficult and probably impossible to obtain the necessary standards of cleanliness and comfort in facilities that are open to the general public.

In but very few instances is the quality of airport restaurants up to minimum standards as far as needs of air travelers are concerned. I think the time is here when a well run, high-class restaurant can be made to pay at practically any one of the major airports. There are several outstanding examples where the restaurants are attractive, where good food is served, and the operators of these restaurants are making money. In contrast to these few outstanding examples, however, the average airport restaurant would not do credit to a bus station. Many airports lack provision so that passengers can board or deplane from aircraft without getting out in the rain and walking some distance. All weather canopies for protection against both precipitation and sun seem to be an essential part of a proper terminal facility. At a number of places it is now necessary to use individual umbrellas and similar makeshift devices which are certainly not in keeping with the standards of service that the air lines want to maintain.

Viewed in the light of certain expansion, parking facilities at most airports are at present wholly inadequate. In addition to outdoor parking facilities, the ideal airport should also include a garage for the use of customers who are planning to return within a day or so and find the storage of their car at the airport during their absence a decided convenience.

There is much that can be done further to improve the general appearance of airports and the approaches to those airports. The airport, far more than any railroad terminal, lends itsef to beautification by the Park Department. Enthusiasm should be developed to make the airport the principal park project of the municipality. With the development of pride in the municipal airport as a public park I think it is almost equally important to be sure that the municipality provides in its operating personnel the best management, courteous policemen and attendants. Very often the whole atmosphere of an otherwise well equipped airport is destroyed through discourteous, and unprepossessing municipal employees who give to the air traveler a distinctly bad impression of that community. An airport administration which provides an appearance of military proficiency in the deportment of all personnel, whether air line or municipal, instills confidence in keeping with the major effort of the airlines to provide safety. This is particularly important. There is nothing which detracts so much from the creation of confidence as the hurrying about of many personnel, the indifference of personnel or the appearance that the whole terminal operation is being conducted without precision and order.

Considerable improvement certainly can and should be made in the handling of airplanes at loading stations, and the mechanical accessories which are involved. The innumerable gasoline trucks, air conditioners, loading stands, baggage carts, and electrical equipment duplicated by each operator should be studied for simplification. The simplification of these facilities will require a higher degree of standardization among the air lines and a genuine effort on the part of the air lines to work together in the handling of commonly necessary and commonly used ramp equipment. The Operations Committee of the Air Transport Association has given this subject attention I know, but I feel confident that further study can bring about desirable action. A common air conditioning plant, for instance, with underground supply lines to take care of all air lines at any one terminal would seem to me a worthwhile, efficient and economical development. Certainly as our volume increases we should give considerable thought to the handling of mail and in future terminals see if provision cannot be made for underground conveyora or similar devices for the expeditious and economical handling of this considerable portion of our cargo.

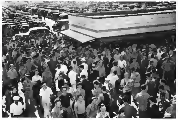
One further point: in the construction of future terminal buildings, particular attention should be paid to acoustics to permit the efficient operation of public address systems, again using the average railroad station as a horrible example as a condition that we should avoid.

Most of these things are obvious but they are correctible, not immediately, but by constantly keeping after them they can and will be improved in most instances. One of the best points of approach, as far as the municipal airports is concerned, seems to be the development of an understanding on the part of municipal officials of the importance to their city of having the hundreds of thousands of air travelers speak well of the portion of the city that they see. The airport reflects, to a great number of air travelers, the whole city. It should make them want to talk about it as a good place to be, a good place to live, and a place that they want to come back to.

By Paul E. Richter

Executive Vice-President, Transcontinental and Western Air, Inc

*Given before Annual Meeting, Air Transport Association



Lockheed canteen is operated by employees. Profits are used for several kinds of employee activities.

Management's Part in

PERSONNEL RELATIONS

By R. Randall Irwin

Manager Industrial Relations
Lockheed Aircraft Corporation

In Part I of this article the author told how Lockheed selects its men. Mr. Irwin now shows the other half of a carefully worked out plan—and tells how employees' good will is maintained through a wise industrial relations program.

HAVING EXPLAINED in a preceding article how Lockheed selects its employees with the utmost care, we now enter the second but equally important phase of our personnel program—that of employee-employer relationship.

We at Lockheed have been fortunate to have worked together in an atmosphere of harmony with a noticeable absence of internal strife. This situation, we believe, is attributable to, not only the comprehensive employee selection program previously discussed, but is also due to the general industrial relations program we are covering in this article.

No company is entirely free from individual injustices and grievances. These are inevitable in any rapidly growing industry or individual factory. We have made our share of mistakes, but I would venture the opinion that the harmony existing between the employees and the management at Lockheed is accounted for by the employees' confidence in the sincere desire of management to do the right thing by them.

This policy was aptly expressed by Robert E. Gross, president of the company, in his annual report to employees. "The years," he said, "have taught us that where there is understanding there is team-work, and with the hope and belief that team-work is with us and with us to stay, I respectfully render you my report."

Freely discussing the company's condition and problem, Mr. Gross introduced his report as follows: "It is a privilege and a duty to tell you about our business during the year 1938. It is a privilege because I like to feel that discussion brings us closer together. It is a duty because I think you have a real right to know something of the problems which we have faced together—problems which as we solve them, make our company and our jobs more secure, and when unsolved, make our jobs and company less so."

Thus, at Lockheed we have proceeded on the theory that rank-and-file employees are just as eager as the management to keep the plant operating on a sound basis, and we have assumed that there is a mutuality of interest in keeping out those misunderstandings which might result in a disruption of work and loss of pay checks.

It is only natural that, having selected an intelligent, healthy-minded group of employees, we should have complete confidence in their ability to get along well with each other and to arrive at reasonable conclusions concerning matters affecting their own and the company's welfare.

It is because of this absolute confidence in the judgment and good sense of our employees that we can freely accept the principle of dealing with them collectively through representatives of their own choosing. During the two and a half years of operation under an exclusive agreement with a local of an international union, we have never failed to come to a mutually satisfactory settlement of a difference that appeared to exist.

This apparent harmony, however, does not "just happen." The union agreement provides a systematic plan for settling all grievances and differences. If an individual employee does not wish to present his own case to the management, he may refer it to the departmental representative of the union, who, in turn, will discuss the matter with the foreman or department head in an attempt to reach a satisfactory settlement. Failing in this, the problem is referred to the union's business representative and the company's manager of industrial relations. If the grievance is not settled at this point, it is submitted to a joint committee of seven representatives of the union and a like number of the management. Only twice in two and a half years have individual grievances gone as far as the joint committee, although this body meets regularly to discuss group problems pertaining to wages, hours, and working conditions.

While employees are represented by a bona fide union in matters directly pertaining to their work, the management recognizes the Lockheed Employees' Recreation Clubs as the sole employees' organization for dealing in all other matters, including organized sports, entertainment, welfare, and to a degree, education. Every Lockheed employee is a member of the "L.E.R.C." and has the right and privilege of voting and participating in all the club's activities. There are neither dues nor entrance requirements. The Lockheed Employees' Federal Credit Union, chartered by the Federal Government, is a unit of the L.E.R.C.

Although most of the activities of the L.E.R.C. are on a self-supporting basis, the management occasionally assists in financial or other ways, as needed. This, however, never extends to the point of supervising employee activities. Throughout, the management maintains the policy that the employees should do everything they can for themselves. This policy, we believe, tends to develop a high type of leadership among the employees, and prevents the development of a relationship that smacks of paternalism.

An outstanding example of the practical application of this policy is

(*Turn to page 109*)

An evening class in shop drafting and blue print reading at a Burbank high school—part of the Lockheed educational program

Nearly one-third of all Lockheed employees attend trade extension classes to prepare themselves for better jobs with the company.

President Robert E. Gross congratulating graduates of one of Lockheed's trade extension classes.

Outwitting the Wind

The story of a brand-new addition to the Link Trainer. Now the vital factors of wind direction and velocity may be added to instrument training methods.

By J. D. Mountain

Instrument Flight Instructor, Transcontinental and Western Air, Inc

ONE of the most serious difficulties in flying on instruments is occasioned by the effect of wind of unknown velocity or direction. Information concerning wind is least available at exactly the time it is most needed. To some extent this condition is being alleviated by upper air soundings of radiosondes, but it is still necessary to assume that the pilot is at all times subject to wind which he cannot accurately estimate and which may change materially in direction or strength without his knowledge.

Nearly all instrument flying is done when the wind is of moderate velocity and its direction is fairly well known. Because of this fact, the methods of orientation and of instrument navigation, which have been developed, have turned out to be inadequate when winds were of very much greater magnitude than normally, or when their direction was radically different than expected. This is indicated by the fact that several serious delays in scheduled flights and perhaps even some serious airplane crashes, have been caused either directly or indirectly by the fact that the winds encountered by the pilot were different than he expected or were of much greater velocity than he expected.

The navigational methods which were worked out in winds of moderate velocity—not more than forty miles per hour—were found to be totally inadequate to cope with situations in which wind exceeded 60 or 80 miles per hour. While winds of such magnitude are unusual in instrument flight, the serious consequences which may result in a pilot's inability to handle his flight under such circumstances, makes it highly desirable to redesign our methods of instrument navigation. Pilots must be trained in such a way that no wind, however great its magnitude or whatever its direction, can possibly confuse them or interfere with the flight.

Unfortunately, it is not possible to predetermine direction or velocity of the wind during intentional instrument flight training. One must needs fly in the wind which exists at that time. To overcome this difficulty, the Link Trainer provides an excellent medium, provided that the effect of the wind of any direction or velocity may be predetermined and accurately simulated automatically. This has been accomplished at Transcontinental and Western Air, by the design and construction of a wind simulator in connection with the Link Trainer. When this device is in use, the direction and velocity of the wind may be set once and for all. Then the instrument automatically sets the correct drift and the correct ground speed, no matter what the heading of the Trainer.

Wind speeds from zero to 100 m.p.h. may be set on the machine, and the direction of the wind may be from any point in the circle. Either the

The Mountain Wind Simulator is a supplementary device that can be tied in with any Link Trainer for teaching pilots to overcome effect of strong winds.

direction or the velocity of the wind may be changed at will during the progress of a problem. Developed by the author for use in TWA instrument flight training in the Link Trainer, the device is also in use by United Air Lines, Civil Aeronautics Authority, Northwest Air Lines, and units are under construction for other agencies. All manufacturing and selling rights are controlled by the author.

The principle of the wind simulator is simple but is theoretically and practically correct. The accompanying photographs show the general machine, in which it is seen that a plate is mounted on the Link Trainer recorder on which the chart is mounted. A pen on the fixed arm of the machine traces its marks on the chart. Thus the direction and speed of the chart mounted on the Link recorder represent the heading and air speed of the Trainer. This whole chart assembly is supported on a moving belt, whose speed may be varied proportionally to the speed of the wind. The direction of the simulated wind is determined by the orientation of the chart with respect to the moving belt. The fixed pen thus traces the resultant of the air speed and heading vector, and the wind direction and speed vector. This is the track and ground speed of the simulated flight. Because it is completely automatic, drift and ground speed corrections are continuously made during the entire flight, even during turns. After once setting the direction and velocity of the wind, the operator need pay no more attention to the device.

As soon as this device was placed in operation in routine training of TWA pilots more than a year ago, it became apparent that a need existed for additional training and research in instrument flight and navigation in winds of high velocity. While the effect of a known wind on dead reckoning problems is easily calculated, in radio range navigation in unknown winds our previous methods have been inadequate. For instance, in the 90-degree method of radio range orientation, which had previously been considered very reliable on square ranges,

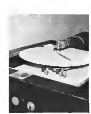


Chart is mounted on a plate on the Link Trainer recorder. A pen on the fixed arm traces its marks on the chart. Entire chart assembly is supported on a moving belt whose speed may be varied proportionally to the speed of the wind.

it was found that a wind of 85-m.p.h. made the solution of this problem completely false. Fig. 1 illustrates this difficulty. In this figure, orientation is shown by means of the 90-degree method under two different circumstances.

At position A, Fig. 1, a plane starting in the "N" quadrant, would, without wind, intercept the leg, make a right turn, and recross the leg back into the "N" quadrant. However, with an 85 m.p.h. wind and a 120 m.p.h. air speed, the flight would not recross the leg, thus the orientation would not be proved.

At starting point B, Fig. 1, a pilot working the 90-degree problem, would, without wind, cross the leg and go farther into the "A" quadrant, thus proving his position near the southwest leg. However, with a wind of

(*Turn to page 112*)

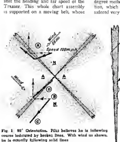


Fig. 1. 90° Orientation. Pilot believes he is following course indicated by broken lines. With wind as shown, he is actually following solid lines

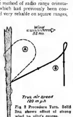


Fig. 2. Procedure Turn. Solid lines shows effect of strong wind on pilot's course.

Fig. 3. Effect of wind on a Square.

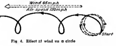


Fig. 4. Effect of wind on a circle

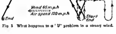


Fig. 5. What happens to a "U" problem in a strong wind.

Trends In Air Transportation

A brilliant and timely forecast of air transport's promising future

By T. P. Wright*

Vice President and Director of Engineering, Curtiss-Wright Corp

"AIR POWER" is being thought of more often these days than "air transport." Since Munich, "air power" has assumed a dominant role in world affairs In this country we are fortunate in being able to maintain a better balance between military and commercial aviation While it is absolutely essential that we continue to build up our air force unless we wish to be lambs in a world of wolves, we must also look into the future and study the possibilities and objectives of air transportation This is important now and will be even more so after the present conflict is ended

Progress in air transportation has been so rapid in recent years that it is obviously filling a vital need When a new method of transportation enables men and their goods to be moved from place to place three or four times as rapidly as was previously possible, a worthwhile advance in civilization has been made Studying air travel one may ask, is it likely that this new transportation will continue to advance and augment its services, and even become the major means of transportation? To answer this question and to see where we are going in the future it is necessary to study a number of important trends

The rapid acceleration of air transportation is shown in the four sets of curves in Fig 1 Growth in miles of airways, number of passengers, volume of passenger miles, air mail and express has been rapid, especially in 1939 One can only reach the conclusion from these facts that there will be a substantial period of time before any falling off in tendency to increase may be expected

Since growth in domestic air travel comes largely from persons who have previously traveled by rail, it is pertinent to consider the relative cost of the two methods. As the following table indicates, the time-saving factor favors air travel between stations over 200 miles apart by about three and one-half to one The fare differential favors rail travel by a ratio of three

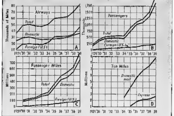


Fig. I Growth of Air Transportation

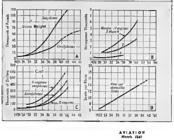


Fig. II Growth of the Airplane

to two, but combining the two in a time-cost efficiency factor, there appears a resultant gain for the air by two and one-half to one.

Table I
RAIL VS AIR
Between Stations Over 200 Miles Apart

	Variation	Average
Speed	.30 to .41 : 1	.33 : 1
Distance	1.05 to 1.22 : 1	1.15 : 1
Time	3.00 to 3.90 : 1	3.50 : 1
Fare	.65 to .70 : 1	.66 : 1
Time-Cost Efficiency Factor = 1/Cost Factor × Time Factor	.30 to .49 : 1	.434 : 1

Fares cited are based on quotations for 1-way trips, including Pullman fares for rail travel, not taking account of reductions for round-trip, for scrip tickets or excursion rates, or other special considerations, such as saving meal costs when traveling by air Combining such factors will react to advantage of air travelers giving a time cost efficiency factor of about 2.5 : 1

A business man who earns $5,000 per year and who flies only at night, thus keeping his days free for work, does not save money by air travel as compared with rail unless he goes 600 miles However, if he travels partly by day he will save money at any distance over 200 miles if he flies

If a man earns $3,500 per year, and travels only at night, he must fly at least 750 miles before air is cheaper than rail If he travels during his daytime working hours, flying is cheaper than rail after 200 miles.

For workers earning $2,000 per year, air travel must be 900 miles or more to be economical, unless flying is done during working hours.

For long distances air travel is so much faster than travel by rail that

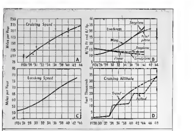


Fig III Airplane Characteristics

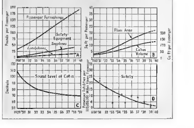


Fig IV Comfort and Safety

the farther one goes, the more he saves in comparison with rail costs This is especially the case if journeys include daytime travel An airline trip from New York to Los Angeles costs about $140, using scrip, as most business men do By railroad, the $2,000 a year man pays $155 in railroad fare, travel expenses and working time consumed The $3,500 a year man pays out $175, and the $5,000 a year man pays out $195

In recent years air travel has grown considerably faster than Pullman travel In 1935 air travel amounted to just over three per cent in passenger miles of Pullman travel The percentage has increased to almost seven and it is reasonable to expect continuation of this tendency, reaching ten per cent by 1945 It is possible that there will be an acceleration thereafter and several have prognosticated a final flattening out at 40 or 50 per cent.

Another factor that has aided air travel has been the reduction in passenger fares made possible by more efficient equipment. In 1929 the average airline fare was 12 cents a mile By 1934 the figure had dropped to 6 cents, and last year it was down to approximately five and one-half cents

Passenger load factor in 1933 was 47 per cent In 1936 it was 64 per cent and in 1939 it was 60 per cent The tendency for passenger load to stabilize at 60 per cent of airplane capacity requires some comment, as offhand it might be considered that a larger amount would be necessary or at least desirable However, there must of necessity be many trips which are 100 per cent filled to attain this average It is also evident that at 100 per cent load factor it is likely that in many cases passengers would be turned away because of lack of seats It appears that the tendency to stabilize at 60 per cent will persist and that airlines must therefore reckon on making their operations pay financially on this basis

Average length of trip is another noteworthy item In 1931 it was 226 miles, in 1935 it had jumped to 420, and in 1939 it was 405 miles The slight decrease in the past few years is due to a tendency for short haul traffic to increase. Last year 95 per cent of trips started were completed

The graphs in Fig II show the growth of the airplane itself. As air travel has grown, airplanes have become larger Curves show trends for the largest sizes of airplanes at each period Tendency of the weight curve for landplanes to flatten out as against the non-existence of any such tendency for flying boats is significant in connection with the different type of service each provides Flying boats for trans-oceanic service require less frequent schedules and make it likely that greater sizes will be developed. The desire for landplane schedules of "every hour on the hour" automatically sets a limit on size increases Landplanes will, of course, increase in size if they are used for trans-oceanic service in the future.

(*Turn to page 115*)

*Based on a paper delivered before the Franklin Institute and before the Maintenance Section of the Air Transport Association.

The Control of VIBRATION in Aircraft

PART II

The second of two articles on the engineering analysis of structural vibration.

By H. H. Bruderlin

Research Engineer
Douglas Aircraft Company, Inc

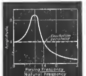


Fig. 4. A. Response of vibrating system to constant excitation varying frequency

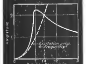


Fig. 4. B. Response of vibrating system to excitation proportional to frequency

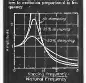


Fig. 5. Effect of damping on a resonant system.

IN the first article (AVIATION, *January*, 1940) we discussed the forces causing vibration in an aircraft structure. The next logical step is to determine the effect these forces will have on the airplane In order to do this we must introduce and explain another term, namely, resonance Unfortunately, the phenomena of resonance, although it is the keynote of almost every vibration analysis, is very little understood by the average engineer. The importance of resonance determination is set forth by the NACA as follows. "Ground and flight tests indicate that unless resonance occurs between a free mode of vibration of the airplane structure and the exciting source, the magnitude of vibration is usually of no practical consequence It follows that considerable reduction of vibration may be obtained by avoiding a resonance of a mode of free vibration of the structure and the exciting sources Because of the large number of independent degrees of freedom of the several parts of the structure, however, the reduction can only be accomplished after close study of the response characteristics of the particular type of structure in connection with a knowledge of the exciting forces"

Briefly, resonance is the increase of motion that occurs in a vibrating system when the frequency of the driving force becomes the same as the natural frequency of free vibration This may be demonstrated very simply by observing the action of a weight suspended on a spring When the frequency of a vibrating force transmitted along the spring is very slow, the movement of the weight is substantially the same as that of the spring support. When the frequency is high, the inertia of the weight causes it to stand relatively still so that it assumes very little of the motion of the spring support. This is the condition that occurs in a good shock mounting device When the impressed frequency is the same as that which the weight assumes naturally, the movement or amplitude of the weight becomes much greater than the movement which causes it. This relation is expressed in Figure 4 as response against the ratio of impressed to natural or resonant frequency. Below resonance the movement is limited by stiffness of the coupling spring, (spring controlled) above resonance by the inertia of the weight, (mass controlled) and at resonance only by the frictional losses in the air, spring, etc. (resistance controlled)

Curve A of Figure 4 applies to the condition of uniform forcing or driving amplitude over the entire frequency range This condition does not hold exactly in an air craft power plant The forces produced by a rotating off-balance weight, such as we have, are non-existent at zero frequency—that is when there is no rotation, and increase in proportion to the square of the frequency or speed of rotation This condition is shown in Curve B For our purposes, it will be seen that the response of a system to vibration is essentially the same whether the excitation remains a constant or varies with speed. From these curves we deduce an important fact: reduction in the amount of excitation to a resonant system, unless it is a very large reduction (15 to 1 or more) cannot remove a bad vibration condition, since at resonance *all* of the power put into vibration is absorbed as friction in the moving parts, and at resonance the vibration is often from 10 to 50 times the amplitude of the force that causes it. A much more effective treatment is thus to merely change the frequency of the free vibration or of the forcing vibration, to prevent resonance. Since forcing frequencies are fixed, the only recourse is to vary the type or stiffness of the mounting in such a way as to shift the free vibration frequency of the engine in the desired direction To raise this natural frequency we make the suspension stiffer To lower it, we add elasticity In practice, greatest benefits are generally derived from lowering the natural frequency as much as possible

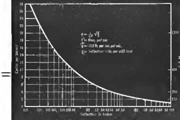


Fig. 6. Natural frequency vs. static deflection.

An airplane power plant has six degrees of freedom, or distinct ways in which it may vibrate, it may move linearly along, or rotate about, each axis. These motions often occur simultaneously and combine with each other in various ways The principal types or modes of vibration of the power plant are:

(a) Angular oscillation about the rolling axis
(b) Motion as a cantilever with a stationary point, or node, at or near the firewall
(c) Angular oscillation about the center of gravity in the pitch and yaw direction.
(d) Angular oscillation of the engine and propeller in opposition to each other, in pitch and yaw directions

Since this last mode of vibration is primarily the concern of the engine manufacturers, we can pass over it in the present discussion This leaves three very important ways in which we may expect any airplane power plant to vibrate. Experience has shown that the resonant frequencies for these modes lies between 400 and 3600 cycles per minute in both rubber mounted and solid mounted power plants as they are normally constructed If the resonance points do not occur in take-off, cruising, warm-up, or idling ranges, the airplane is usually satisfactory, from the standpoints of passenger freedom from vibration, and of structural stress.

The flexibility of an engine suspension is the sum of that of the structure and that of the mounting device. It is often rather difficult to calculate the resonant conditions of the power plant of a new airplane with a sufficient degree of accuracy for design purposes if it is appreciably different from previous models, on account of widely varying elasticity of the structure In construction of new aircraft it is well to design the structure for as high a rigidity against forces from the engine as is economically feasible, and be prepared to make adjustments in the mounting device. A suspension that groups all the resonant frequencies at 600 to 700 cycles per minute would be satisfactory in almost any case. Several types of mounting device are available in which the flexibility in the

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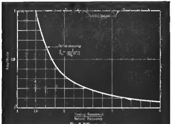


Fig. 7. F/Fo vs. ω/ωn

By
Robert J. Woods
Chief Design Engineer
Bell Aircraft Corporation

Unveiling
The AIRACOBRA

Chief Engineer describes details of Bell mystery ship

DURING the past few months increasing emphasis has been placed on improvement and development of military aircraft, to obtain the maximum speed possible, with improvement in fire power and increase in utility of the aircraft as a weapon a close second in consideration. The designer of the P-39 recognized these trends more than two years ago and realized that if the single engine pursuit airplane was to keep pace with advances in foreign light bombers radical departure from the conventional engineering practices were essential. The result is an airplane designed for quantity production whose performance puts it well in the lead of its foreign competitors. New and novel from nose to tail, the Bell P-39 single place, single engine pursuit, has been built with the aim of carrying the high speed laurels to around the 400 miles per hour mark. The potency of this airplane as a weapon is attested by the 37 mm aircraft cannon and the four synchronized machine guns carried in the nose of the fuselage. The utility of the machine is established by the tricycle type landing gear, the excellent vision provided for the pilot in all directions and the facility for inspection, maintenance and repair made possible by the novel arrangement of the engine amidships, which, together with the relative low wing loading for this type of airplane, produces a degree of maneuverability not possible with the conventional arrangement.

Incorporating aerodynamic and design features heretofore generally reserved for the laboratory, the P-39 is a powerful, complete, fully developed tactical weapon. Completely new in so many respects, the decentralized arrangement of the component essential installations of the P-39 airplane is a most striking feature. Now that it has been done it seems most logical, and offers many advantages.

The installation of the engine near the middle of the fuselage and the use of the extension drive shaft to drive the propeller permit realization of aerodynamic improvements not heretofore practical. The nose shape of the fuselage is optimum for low drag. The location of the heavy weight of the engine near the center of gravity of the airplane provides for economy in structural weight and reduces the polar moment of inertia of the mass of the airplane around the center of gravity to a marked degree which, in turn, provides a degree of maneuverability not possible in an airplane of this size and weight with the conventional arrangement with the engine in the nose of the fuselage. The location of the pilot, approximately on the center of gravity, also increases his ability to stand the physical strain caused by abrupt maneuvers. The vision provided for the pilot is better than that provided in most multi-engine airplanes. It is completely unrestricted forward and down and is not blanketed by nacelles to the side. The projection of the cabin above the fuselage top line and the transparent "turtle back" permit vision directly aft and up. The blind spot to the pilot in all single place pursuit airplanes aft and down is protected from hostile fire by the mass of the engine. In foreign types this protection is achieved by the dead weight of armor plate with the resultant sacrifice of useful load.

The windshield, windows and transparent panels of the cabin are Plexiglas. Two outward swinging doors are provided, one on each side of the cabin, the one on the right side for normal entrance and exit. However, both doors come free for emergency exit by means of quickly releasable hinge pins that can be operated from inside or outside the cabin. Both doors have roll down windows. Large baggage space is provided behind the pilot inside the cabin on the top deck over the engine compartment, which is accessible to the pilot from within the cabin. The pilot's cockpit is neatly, but compactly arranged and provides exceptional room for so small an airplane.

Some of the modern European military airplanes in use now carry automatic cannons which fire explosive shells of great destructive power. In general these guns are 20 millimeter and 23 millimeter bore. The Bell P-39 carries a 37 mm cannon capable of firing explosive shells. It is believed that this airplane is the only single-engine pursuit airplane in the world thus armed. In addition to the 37 mm cannon, the P-39 mounts four machine guns for synchronized fire through the propeller disc. A fume proof bulkhead at the rear of the gun compartment keeps gun gas from the cockpit.

The power plant is manufactured by the Allison Engineering Company, Indianapolis, Indiana. The engine is an Allison, direct drive, Vee, 12 cylinder, liquid cooled. Power is transmitted to the propeller through an extension shaft assembly that is provided with suitable universal joint action and intermediate bearing supports. The extension shaft was designed with full consideration of the factors of fuselage deflection for all conditions of flight and power, and has shown no defect or fault in over 500 hours of full power testing on the test stand and in flight. The independent reduction gear box is attached to the front end of the fuselage longitudinal beams and drives the hollow hub propeller. The offset of the reduction gears permits the installation of the 37 mm cannon on the propeller shaft centerline. The gear box also mounts the propeller governor, propeller bush housing and gun synchronizers. It has a completely independent lubricating system and oil supply. The weight of the power plant is surprisingly low, being only a little over the weight of the standard V-1710 Allison engine. The oil radiator is located in the right hand wing root and the prestone radiator in the left hand wing root. Shutters are provided to control the engine temperatures.

The three elements of the tricycle landing gear are completely retractable in flight. The retraction mechanism is mechanical, operated by an electric motor, or by hand from the pilot's cockpit. Hydraulically operated Goodyear, 11 plate multiple disc brakes are used in the rear wheels. Of interest, from a design standpoint, is the hydraulic stabilizer built integrally into the fork and shock absorber of the nose wheel to prevent the occurrence of "shimmy" of that element and at the same time provide suitable caster action to permit the P 39 airplane to be steered readily on the ground. The landing gear is arranged so that the thrust

(*Turn to page 104*)

Tricycle landing gear retracts and is completely faired. Note air scoops in leading edge for oil and radiator.

Narrow, tapering nose and unusual amount of windshield and window area give pilot excellent visibility in several directions. Carburetor air scoop is just off of cockpit cover.

Allison V-12 liquid-cooled engine is behind the pilot and an extension drive shaft runs forward to the propeller. Engine location near center of gravity gives added maneuverability to this sleek fighting ship.

The author made extensive use of the N.A.C.A. and Wright Field laboratories in his ingenious design

1940 Annual Meeting of the Institute of the Aeronautical Sciences

DRAWINGS BY KORN

EACH YEAR the annual meeting of the Institute of the Aeronautical Sciences elevates its position as the most important engineering meeting of the industry This year, the eighth, has not been unlike the others in this respect, with the notables attending giving a number one cross-section of those who represent aviation in this country.

Under the capable supervision of Lester Gardner, Executive Vice-President of the Institute, the sessions lasted three days being climaxed by the Honors Night dinner Friday, January 26. The papers presented were all of importance to their respective phases of the industry and the following several excerpts are aimed at giving a representative view of what was discussed behind the doors.

Some Economic Aspects of Transport Airplane Performance

By W. C. Mentzer and Hal E. Nourse

Total air transport operating costs are divided into three classifications (1) Significant operating costs which are defined as those resulting from the flight of an airplane or those affected by variation of airplane size, power, initial cost and aerodynamic efficiency, (2) Passenger service costs which are defined as those which vary with the number of passengers aboard an airplane are enumerated, and (3) Overhead costs in air transportation and it is concluded that these costs change their proportion to significant costs when the physical and performance characteristics of the airplane being considered change. . . .

Economic factors apart from those associated with fundamental airplane design and performance, such as interior arrangement, safety records, competition and general economic conditions, play the major role in the economic outcome of air transportation

While only one general type of airplane was investigated in this study the method of attack, that is, the idea of expressing certain airplane characteristics in terms of significant cost, is applicable to any type of transport airplane Further experience with the method will undoubtedly result in simplification and increased accuracy.

"The CAA Instrument Landing System"

By Henry I. Metz

The instrument landing system at Indianapolis is the most extensive and most complete system ever to be installed anywhere in the world. It is an installation providing for instrument approaches and landings in four different directions. All of the sixteen stations involved are completely controlled and monitored from the airport control tower and there is a graphic recorder which continuously writes down the monitor readings while the system is in operation. . . .

The system is the so-called "three element" type consisting of localizer, glide path, and markers The localizer, or element number one, provides lateral guidance to permit the pilot to bring his airplane from the national airways radio range courses to a position in line with the exact centerline of the runway on which the landing is to be made The second element, the glide path, provides vertical guidance to permit the pilot to keep his airplane always on the correct path of descent, always a prescribed distance above the obstructions on the approach and always to the same point of contact on the airport runway The markers serve as distance guides and check points during the approach procedure. . . .

The runway localizers are really miniature two-course radio ranges with their courses aligned exactly with the centerline of their respective runways. . . .

The monitor and control desk which provides supervisory control is located in the airport tower Through the use of a selector switch any one of the four directions of approach may be selected and the stations associated with the selected approach are indicated by small lights on a miniature airport layout on the surface of the desk. . . . A graphic recorder is located on the front of the desk and when the system is in operation this recorder keeps a record of the monitor signal from each transmitter and indicates which direction of approach was in operation. . . .

Counter-Rotating Propellers

By H. M. McCoy, U. S. Army Air Corps

This paper is concerned mainly with that application of counter-rotating propellers referred to, for the sake of brevity, as "dual-rotation" This term is defined to apply to a pair of oppositely-rotating propellers operating in close tandem, mounted on concentric shafts . . .

This paper presents a summary of the development and background of dual-rotation propellers and the benefits that can be derived from their use. . . .

The application of dual rotation propellers include multi-motored airplanes with oppositely-rotating propellers, airplanes with engines mounted in tandem (back to back) so that the propellers revolve in opposite directions, but primarily, airplanes with dual-rotation propeller installations

Sustained level flight airplane velocities appear to be limited to about 550 m p h when propellers are used as the means of propulsion The efficiency of a conventional single-rotation propeller will be so low, however, that this limiting velocity can be approached with such a propeller only at a prohibitive cost in engine horsepower. Any given velocity above 300 m p h

(*Turn to page 122*)

Presenting the Curtiss-Wright Transport

A MODERN AIRLINER is the brain-child of many men and the work of many years It is backgrounded by painstaking analysis of the basic operating requirements both technical and economic And during the long period of development the design must be modified to suit the ever changing needs of the fastest-moving transportation industry

The new Curtiss-Wright Transport has run the gauntlet and has emerged a finished product The economic philosophy behind it goes back to early considerations of power plant distribution Out of an analysis of this problem (reported by A. E. Lombard in AVIATION, July, 1937) came the decision to concentrate the power into two engines with the resulting economy in operating and maintenance costs while still obtaining the performance characteristics

Next came the need for a pressure cabin to meet the demand for high altitude operation Here design ingenuity had to be focused on obtaining a highly efficient structure to provide increased strength without heavy costs in weight.

These basic problems are representative of the many that were solved before the machine came into being But how they were solved is best told by the men who did the job And their stories are presented on the following pages

Guy W. Vaughan,
President
Curtiss Wright Corp

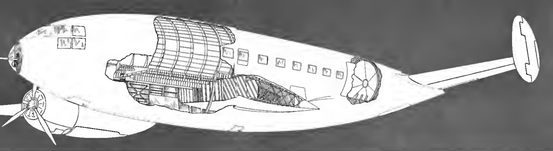
Theodore P. Wright,
Director Engineering
Curtiss Wright Corp

Charles W. France,
Vice Pres., Gen Manager
St Louis Division

George Page,
Chief Engineer
St Louis Division

Lessiter C. Milburn,
Works Manager
St Louis Division

Dean Smith,
Sales Director
St Louis Division



An Engineer's Close-up of the Curtiss-Wright Transport

In the design of the fuselage structure of the Curtiss-Wright Transport two fundamental design considerations predominated. These were (1) the development of a shape which would allow a large cargo capacity and would locate the disposable load as near to the center of gravity as possible, and (2) the development of a shape and structure which would allow pressurization of the cabin for high-altitude operations. On the basis of these considerations, the Curtiss-Wright engineers developed a basic cross-section composed of two intersecting circles joined together by a common chord through the points of intersection. The use of this cross-section presents several advantages allowing as it does a more efficient utilization of the enclosed space as compared with a similar circular cross-section while the use of circular arcs above and below causes the loads on the fuselage wall due to the pressurization to be taken out as tension loads in the structure. This shape is employed in the region of the cabin, at the widest portion of the fuselage. Aft of the cabin the shape is somewhat modified tapering to a tail cone.

The fuselage is of the semi-monocoque type of construction having a shell made up of reinforced 24ST Alclad sheet with stringers and forming rings of the same material. Forward of the bulkhead which is located just aft the pilots' compartment, the skin is flush-riveted, while aft of this point modified brazier head rivets are used.

Fifty-one fuselage rings are employed. These are formed channel sections of 24ST Alclad sheet with the exception of those rings to which the center section of the wing and the tail wheel are attached. The rings are riveted directly to the skin.

The skin is reinforced by stringers of 24ST Alclad sheet rolled into a Zee section, this particular cross-section having been chosen only after extensive tests of various types and shapes had been made. Formed sheet material was used for the stringers in preference to extruded shapes because of its lightness and the ease of rolling it to the desired cross-section and because it may be obtained as Alclad stock that is, coated with a corrosion-resistant coating of pure aluminum. Also the use of stringer material of the same specification as the skin allows a more homogeneous structure than would be possible with the use of extruded shapes the physical properties of which are somewhat different from sheet.

A feature of the fuselage shell lies in the pattern and layout of the stringers. A constant circumferential spacing is maintained between any two stringers throughout the length of the airplane, individual stringers dropping out by merging with a central keel member as the diameter of the fuselage decreases. This eliminates stress discontinuities caused by abruptly-terminated stringers. The stringers, which are riveted to the skin, pass through cutouts in the rings, clips being employed to fasten the stringers to the rings and also serving the purpose of stabilizing the rings themselves, allowing them to develop a higher allowable stress.

A pressure rib is installed in the wing center section on each side, in approximately the region which would be occupied by the fuselage wall. The function of this rib is to form a pressure seal for the wing for pressurization of the fuselage, and at the same time to act as a shear beam in transferring some of the loads between the spars of the center section at the fuselage attachment. The lower portion of the fuselage structure in this region is attached to the lower surface of the center section by means of a splice angle, the skin and outer portions of each ring in this area being attached to the splice angle, while the inner edges of the rings are clipped to the skin of the center section for stability.

The floor of the airplane, which is the connecting member between the upper and lower arcs, becomes a structural member of the fuselage when pressurization is installed, taking out as tension the loads arising from the pressure loads on the fuselage walls. The floor is constructed of 24ST Alclad sheet set upon transverse channels of the same material, rolled to shape. These in turn are supported on longitudinal girders which are fastened to the fuselage structure at the forward and aft ends of the floor and to the wing center section. The transverse channels are bolted to an extrusion which runs forward from the pressure bulkhead to the nose of the airplane at the intersection of the upper and lower arcs on both sides of the fuselage. This connection serves to transfer the floor loads directly to the fuselage structure.

The tail wheel assembly is mounted in the rear of the fuselage and retracts into it. The tail wheel ground and retraction loads are transferred to the fuselage structure through special reinforced bulkheads and attachment fittings.

WHEN the Curtiss-Wright Corporation's St. Louis Division engineers began designing the new 36-passenger Transport which has just recently been completed in that factory, they were not planning to produce the first twin-engine airliner ever designed for substratosphere flying. They were thinking rather of turning out an airplane that could perform a specific function efficiently; they thought in terms of operating economy, high payload ratios, low maintenance costs, and high performance characteristics. How the engineering details necessary to produce these characteristics were carried out, has furnished fuel for many a drafting room conversation throughout the industry. It is the purpose of this article to give an engineer's eye-view of how a few of the transport's salient features were worked out.

Safety features have been designed and built into the ship both structurally and aerodynamically. One of these safety assets is the provision against wing tip stall. The means used has been the gradual alteration in aerofoil section from root to tip, coupled with use of moderate washout of angle of attack. This is not an untried design but is rather a modification of previous designs used on Curtiss-Wright ships. From experience, records show that structurally the landing gear has been the weakest point in the past. To reduce to a minimum possibilities of landing gear failure, an extra length Oleo stroke has been used that will withstand a descent of 800 ft. per min., far greater than that normally used or required. In addition a locking device has been installed that will not permit the gear to be raised once in the down position with the weight of the ship on it. Another example of the thought of safety that was carried throughout the design is the location chosen for the fuel tanks. These are in the outer

By

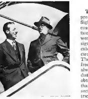
George A. Page

Chief Engineer
St. Louis Airplane Division of Curtiss-Wright Corporation

As Told To

Jay P. AuWerter

Assistant Editor, Aviation

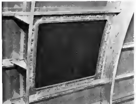


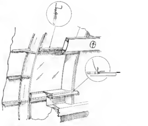
George Page, left, and Les Milburn, works manager of the St. Louis Airplane division.

panel of the wings, at a distance of near 30 feet from the cabins, reducing the hazard of fire in case of an emergency. As a safeguard against pilot error the Curtiss-Wright "Tell Tale" instrument was devised as a visual indicating unit showing by signal lights when various control of the operations have been omitted or improperly performed. (See AVIATION, March, 1939, pg. 54)

Fuselage

Turning first to the problem of pressurization to meet high altitude flight, giving increased passenger comfort for normal flight operations, several special stumbling blocks were uncovered. In the general design procedure for weight economy, cabin pressure must be retained by circular elements wherever possible. The complete circle is, of course, ideal from a pressure standpoint but is not always the most suitable for space distribution required. One method of obtaining considerably greater depth than width is by means of a cross section consisting of two non-concentric arcs with the floor serving as the stay member at the points of intersection. This type of construction was described in an article on the transport by T. P. Wright, Vice-President, Curtiss-Wright Corp., in the August 1938 AVIATION (page 29). Once this type of construction has been chosen there arises the problem of the necessary strength requirements to withstand all of the various loads imposed upon the fuselage. Consolidating these loads into three groups we have: (a) Those due to wing, tail and landing gear reactions; (b) those due to useful load or dead weight items lo-





The window panes are of transparent plastic, recessed to be flush with the external skin of the fuselage, and presenting a clean aerodynamic surface with no protruberances into the air stream. The panes are also curved to conform with the curvature of the fuselage, presenting a clean appearance. Each pane is secured in position by means of an external rim, which is flush with the outside fuselage skin and fits into a machined-out notch on the circumference of the outer face of the pane (See insert) The rims are fastened to inner retainers by counter sunk flat-head machine screws fastened into self-locking gang channel nuts riveted to the inner retainer around the window frame the panes being clamped tightly between the outer rims and the inner retainers. The windows are so proportioned that the inner retainers are directly fastened to conventional fuselage stringers and rings.

The windows are sealed around the edges by a rubber-cork sealing tape the seal being made between the window panes and the outer rims and inner retainers respectively The sealing tape is held in place by means of a sealing cement providing a water and air-tight joint yet allowing the pane to expand and contract freely with changes in temperature. Below the window is a shelf

cated within the fuselage structure, and, (c) those due to the differentials of pressure between the inside and the outside of the cabin.

With these loads in mind the problem develops into one giving a structure which would satisfy five different conditions, namely, that: (1) The maximum imposed load likely to occur shall not impair or permanently deform the structure, (2) A sufficient reserve of ultimate strength should be provided to cover exceptionally severe loading conditions This requirement is intended to provide the highest possible degree of ultimate safety, so that if some damage, such as permanent distortion of structure should occur, it is of no special concern under these conditions (3) The structure should have a margin of strength sufficient to cover a reasonable amount of deterioration during its service life This includes such items as wear, fatigue, corrosion, and reduced strength due to normal repair work (4) A reasonable allowance should be made for normal variations in materials of construction and fabrication processes. (5) Allowance should be made for uncertainties of analysis methods and criteria.

These five considerations constitute the basis for the establishment of a design load factor for practically any condition where strength is of basic importance Following along with the problem it appears that a practical design might be accomplished by use of the following design load factors: (1) For a steady flight condition superimpose upon the loads due to normal unaccelerated flight those due to the maximum probable pressure differential, the latter to be multiplied by a constant which would provide for fatigue, creep of the material, and the excess pressure possible before the safety valves would open (the factor is between 1.25 and 1 50). (2) For momentary accelerations the pressure loads without the factor for fatigue should be superimposed upon the critical limit flight loads It was with this analogy that the pressurized cabin was designed

Along with the solution of this problem many smaller but very important problems present themselves One of these is the riveted seams This problem arises from the desire to use a minimum number of standardized rivet patterns, reducing production costs while at the same time obtaining a joint that would have required strength under all conditions. The result became a multiple-row pattern with generous spacing of outer row rivets The rivet rows were placed close together since by this arrangement the difference of strength between the sheets is reduced to a minimum, and the unit loading on the outermost rivets is not appreciably higher than the average for the entire pattern

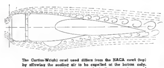
Once the rivet pattern had been decided upon it is necessary to find some method of sealing the joint so that the pressure will be retained inside of the cabin After a considerable amount of research with test specimens, it was found that one of the most reliable and at the same time economical methods of sealing was merely to paint the inside of the surface of the seams with a suitable compound. The latter should have a moderately heavy body and be of a permanently gummy nature which does not become brittle hard with age or at low temperatures of high altitude flying Where gaps are encountered as in the intersection of a stringer with a pressure rib, a strip of cloth can be used as a base for the fill or sealing compound Sealing the door is done quite differently, however, because neither the door nor the frame can be considered to be especially rigid A flat tube is inserted in the space between the door and the frame and is inflated, after the door is closed The de-icer pumps furnish a convenient pressure supply for this purpose To off-set its apparently greater complexity, this system has the advantage of creating an air-tight and therefore a more sound tight seal even when flying without pressurization.

Wings

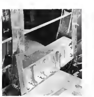
Because of the added weight due to pressurizing the cabin, it was of utmost importance that the remaining parts of the ship combine a great strength with as low weight as possible With this in view, the design chosen for the wings was of the stressed skin type, in which the axial loads due to the bending of the wings under load, are carried in the stiffened skin The stiffened shear webs have extruded flanges next to the skin. In the center section of the wing three such shear webs are used, but in the outer panel only two are employed

In addition to the shear webs, support is given to the skin by rolled sheet stringers which are laid in a "Herringbone" pattern largely terminating at their outer ends into the main beam, thus avoiding the stress discontinuities which arise from abruptly-terminated stringers These stiffeners, which are of a special hat-shaped design selected by test to give the maximum strength weight ratio, are so spaced that their support is practically uniform over the entire surface, thereby eliminating the tendency of the wing skin to wrinkle under normal loads This minimizes a source of parasitic drag which has heretofore been objectionable in large stressed skin wings. As a further aerodynamic refinement, the stringers are attached to the skin by means of flush rivets, presenting a smooth, low-drag surface The stringers were fabricated on special rolls from material of the same specification as the skin itself (24 ST aluminum alloy) thus taking advantage of the condition of identical physical properties in both the skin sheet and the stiffeners

The ribs are of sheet metal construction, of both the web and truss types. Web-type ribs are used in the outer panels, near the inner ends



The Curtiss-Wright cowl used differs from the NACA cowl (top) by allowing the sealing air to be expelled at the bottom only. This permits a smooth uninterrupted air flow over the top of the wing which is spoiled by the louvers in the NACA cowl.



Connection of the wing center section to the fuselage is made by means of four wing attachment fittings in the fuselage mounted between reinforced fuselage rings two at the front spar of the center section and two at the rear spar The attachment of the wing to the fittings and of the fittings to the rings being made in such a manner that the fitting is loaded as a simple beam (above)

The flap arrangement operates first as a slot when moved rearward from the closed position (Figure 1 to Figure 2, left to right). From this position the flap moves rearward and downward (Figure 3 and Figure 4), operating over a range of 60 degrees. Hydraulically operated by a main piston located in the center section, the flap mechanism is motivated by a cable and push-rod system.

where they support the fuel tanks. Light, stamped sheet metal ribs are employed in the vicinity of the wing tips. The two tank support ribs in each wing are of heavy, reinforced sheet, with padded openings to accommodate the fuel tanks. The truss type ribs are constructed from rolled sheet metal hat-sections, and are employed throughout the center section of the wing and in the outer panel outboard of the tank support ribs. In all cases, the ribs are not attached directly to the skin, but are fastened to the stringers by means of clips. Due to the use of deep stringers, the ribs are spaced more widely apart than is common in similar wings.

The center section is continuous completely through the fuselage, supporting the engine nacelles and the landing gear attachments. The outer panels are bolted to the center section just outboard of the nacelles, each outer panel being attached by a number of special high-strength bolts. Easily accessible splice bolts are recessed within the wing contour thus having no external protuberances and reducing to a minimum the structural eccentricity.

Servicing, moderate repair work and inspections are facilitated by the removability and interchangeability of the leading edges and wing tips of the outer panels. In both cases these attachments are completely flush with the surface of the wing. Each outer panel is also jig-built to assure interchangeability, so that in the event of damage to one panel, another may be substituted for it with no special fitting operations required.

Wing Flaps

The flaps are of the full trailing edge, rearward-moving, slotted type, possessing advantages not found on the conventional type of split flaps now in use. Hydraulically operated, with a follow-up system to regulate their travel, they may be controlled to any position by a single movement of a lever on the pilot's control pedestal. Movement of the control lever to the required flap position opens a valve on the actuating cylinder, causing it to move the flaps to the predetermined position, at which point the follow-up system closes the valve and stops the motion, maintaining the flaps indefinitely at that position until the control lever is readjusted.

The flaps are given their motion by the parallel linkages to which they are hinged. These linkages cause the flaps to move first rearward and then rearward and downward so that the overall effect obtained is to increase the wing area and camber. Thus small flap movements rearward will give a high gain in lift with little increase in drag—a condition desirable for improving take-off performance. The last part of the flap in downward motion gives little change in lift, but produces a large increase in the drag—this combination being ideal for landing conditions. An appreciable gain in lift is obtained by means of the slot which opens between the leading edge of the flap and the wing when the flap motion commences. This slot smooths out the air flow over the top of the flap and improves the wing lift curve at high angles of attack.

The flaps are of metal construction, fabric-covered, and extend from the fuselage to the ailerons. The motion of the hydraulic actuating cylinder is transmitted through cables to the flap linkage mechanism, which is contained within the wing. The forward edges of the slots are approximately normal to the lower surface of the wing, allowing free air flow with the flaps extended, but providing no possibility of ice formation even under the most severe conditions, which might impede the flap operation.

Cowling

A noticeable difference between the cowling on the Curtiss-Wright transport and the conventional cowling is that while the conventional cowl discharges the exit air evenly around the periphery at the trailing edge, the Curtiss-Wright cowl is completely sealed around the upper portion at the trailing edge and all the cooling air escapes through an opening in the lower portion. This "tunnel type" cowling, as it is called, affords several distinct advantages. By eliminating the cowl "skirt" opening in the region of the upper surface of the wing, interference between the air flowing out of the cowling and the air flowing over the wing is avoided. This results in a noticeable decrease in drag, and a favorable effect on the stalling characteristics of the wing.

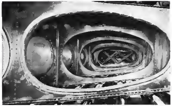
Cooling is controlled by means of an hydraulically controlled retractable flap which partially covers the exit opening in the bottom of the cowling and serves to regulate the passage of the air. This results in efficient cooling of the engine in all flight conditions, especially those of taxiing and climb, and regulates the flow of air to the extent that the engine may be operated at its most efficient temperature at all times, with lowest drag coefficient.

Structurally, the cowl is fabricated from 24 ST aluminum alloy, flush-riveted throughout. It is of the stressed-skin type of construction, employing sheet skin reinforced with internal stiffening ribs of formed rolled hat-sections.

The cowlings are mounted on the nacelle structure independently of the engines, so that they have no motion with the engines at any time. This reduces the likelihood of fatigue failures due to engine vibration, allowing longer serviceable life, and presents a more pleasing appearance at low engine speeds when engine oscillation amplitudes are larger.

The cowlings are of three-piece

The landing gear when retracted is completely enclosed in the cowl. The lines of the cowl are uninterupted when the doors, which open outward from the center, are closed. For the first time the new Wright R2600 engines are used developing 1700 total horsepower each. These engines are mounted with the dynamic engine mount suspension which reduces the engine vibrations that would otherwise be felt in the cabin.



The fuel tanks are supported at but five points the first and fourth ribs in the photograph. This minimizes bending and torsional loads imposed on the tank by movements of the wing.

construction, each section occupying approximately one-third of the cowl circumference Two of the sections are hinged at the top along the center-line of the cowl, and open upward and outward The third section is equipped with transverse hinge, just forward of the firewall, and opens downward. In this manner, the entire engine is accessible for servicing without the necessity of completely removing the cowling If it is desired to remove the cowling, this can be done in a period of about five minutes

Power Boost Controls

The problem of "pilot fatigue" has come to be recognized as a vital factor influencing the design of such items as cockpit controls, instrument installations, warning signals, etc An important aspect of "pilot fatigue" has been found to be the actual physical fatigue arising from the work that the pilot must do to operate the controls against the heavy surface loads that are encountered in modern large aircraft

The design of the "power boost" system, relieving these loads, is such that small movements of the pilot's controls open servo valves, which allow pressure immediately to build up in the Sperry Pilot hydraulic actuating cylinders, causing the control surfaces to move to a position determined by the amount of movement of the pilot's controls in the cockpit At this point the valves are automatically closed Any desired amount of control surface movement may be obtained by moving the cockpit controls a proportionate amount

When reverse motion of the controls is desired, as in returning the controls to neutral, the servo valve admits pressure to the opposite side of the servo cylinder, allowing the oil in the first side to drain back to the hydraulic reservoir

Aside from the small travel necessary to operate the servo valves, the pilot's controls are directly connected to the surfaces through the same cable and push pull tube systems which are actuated by the power cylinders themselves, making direct manual control available in the remote possibility of failure of the power controls

The system is so designed that as soon as the motion of the control column has stopped, the servo valve is closed, thereby locking the pressure in the servo cylinder and stopping the motion of the controls. The stop on the control column is so adjusted as to be contacted at the same instant as the stop on the control surface, thus halting the entire control system when the surfaces contact their correct stops, and thereby preventing excessive loads from building up on the surfaces from the power control

The power cylinders which form the basis for the "power boost" are also part of the automatic pilot installation, and are connected directly to it Three power cylinders are employed for the aileron, rudder and elevator systems in the airplane, one for each system, with direct connection by means of cables and push-pull tubes to the control surfaces

The use of the "power boost" provides a system which is automatically irreversible at the control surfaces This property is quite advantageous inasmuch as it eliminates the necessity of having external locks provided for the control surfaces to prevent the controls from being blown about by wind while the airplane is parked on the ground. This, however, presents no hindrance to the manual operation of the controls by the pilot from the cockpit.

One of the main features of the design of the transport is the smooth lines of the fuselage greatly reducing the drag The pilot's cabin windows are faired in with the contour of the nose and the glass is flush with the skin as in the passenger cabin. The de-icers along the wing are also built so as to be flush with the skin and run outboard on the wings from the nacelles (not attached in the photograph). Notice the accessibility to the under part of the ship from the ground without the aid of ladders.

MAINTENANCE at a PROFIT

By C. W. France

Vice-President and General Manager
St Louis Airplane Division, Curtiss-Wright Corporation

As told to Carl Norcross

Assistant Editor, Aviation

Battery compartments on each side of fuselage are easily accessible from the ground.

The new Curtiss-Wright Transport is designed to keep maintenance costs to a minimum.

Close-up of one of the two 1700 h.p. Wright Double-Row Cyclones showing unusual cowling. Propeller is Curtiss electric controllable pitch, full feathering type.

OPERATING economy has ever been a major objective for the air transport manufacturer and the air line operator alike. In the new Curtiss-Wright Substratosphere Transport we have incorporated many basic design characteristics assuring operating economies which we believe set a new high standard in air transport maintenance procedure.

This story of our designers' efforts to achieve operating economy does not feature the impressive operating cost figures which already are known, but emphasizes rather that mass of details contributing to the transport's design, the principal consideration of which has been the simplification of maintenance routine with consequent economies. Such factors range from the ease with which a mechanic may replace a complete outer wing panel to the time required for a ship cleaner to clean the ash trays.

Illustrating best the basic design features which reduce direct operating cost, is our choice of two Wright Double Row Cyclone engines to power this transport, rather than a larger number of power plants of less horsepower. The reasons are (a) lower initial sales price reduces depreciation; (b) reduced horsepower required for given performance decreases fuel and oil consumption, (c) a less complicated power plant control system obviates the need for an engineer, (d) the simplicity of a two-engine installation minimizes power plant maintenance and overhaul expense.

Servicing simplicity has been achieved in the design of the Curtiss-Wright Transport by our adherence to four rules or principles of construction.

These rules are:

I. Design and build assemblies interchangeable left and right wherever possible.

II. Make all equipment, controls and moving parts which require servicing entirely accessible to the ground crew and to the flight crew wherever possible.

III. Eliminate stress concentrations in the structural design.

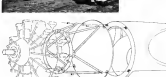
IV. Design all individual details so as to reduce time and effort required for maintenance.

Numerous examples of our application of these four rules may well be presented as illustrating the careful "design for maintenance" which we have incorporated in the new transport. While only a few of them will be mentioned here, our solution of the problems involved typifies the manner in which we have solved the general problems of maintenance effectively.

With reference to Rule I, which provides for maximum parts interchangeability, all parts and assemblies subject to frequent removal may be exchanged between airplanes in service, quickly and easily. All removable major assemblies and many sub-assemblies are jig-built to assure interchangeability of installation so that an unusual number of parts may be interchanged between the left and right sides of the airplane.

The extent of interchangeability achieved in the new transport is best shown through a tabulation. All units listed are interchangeable between planes. Items listed under "A" may be interchanged directly with no fitting required and also are interchangeable between the left and the right sides of the airplane, items listed under "B" are interchangeable without fitting, but are *not* interchangeable left and right: items under "C" otherwise parts which are often designed without consideration of replacement simplicity, are interchangeable between ships but require the alignment of attachments, locating and drilling of attachment holes, etc.

Left: Engine cowling in position, showing air scoop at fully opened position. Landing gear doors close completely to form smooth surface.



Below: Expanded view of power-plant section. Entire section forward of firewall may be detached by removing four bolts.

(A) Parts directly interchangeable between airplanes *and between left and right sides*: complete power plant assemblies forward of and including firewall, engine mounts, exhaust manifold assemblies, removable engine cowlings, firewalls, oil tanks, landing gear assemblies, complete tail assemblies, stabilizers, elevators, elevator tabs, fins, rudders, rudder tabs, stabilizer leading edge.

(B) Parts directly interchangeable between airplanes: outer wing panels, wing tips, wing leading edge, ailerons, aileron tabs, wing flaps, tail wheel assembly, fuel tanks, cabin chairs, instrument panels.

(C) Parts interchangeable between airplanes, but requiring alignment of attachment fittings or holes: engine nacelles, tail cones, fuselage doors and exits, fuselage nose section (pilot compartment), fuselage tail section (aft of ladies' dressing room).

Certain of the most important interchangeable units in this list merit specific comment. The perfection of a power plant installation which may be installed on either nacelle of our Transport, for example, is an outstanding achievement. By removing four engine mount bolts and disconnecting controls and lines behind the firewall, the entire engine assembly with all accessories and cowling may be detached and installed on the opposite side without modification.

Interchangeable also from one side to the other are such items as the firewall, engine mount, symmetrically shaped cowling and oil tanks. Fuel units, including both pumps, both strainers, flow meter and check valves are grouped in a separately removable unit mounted on the firewall in the engine compartment; the complete fuel unit assembly is interchangeable right and left and can be removed by detaching only four bolts.

The leading edges of all fixed surfaces, such as the wing outer panels, stabilizer, and fin are detached by removing a row of flush head screws in each case. This greatly simplifies for the airline maintenance department the problem of repairing the surfaces which are most susceptible to damage. In the case of the stabilizer, removal of the leading edge provides free access to the rudder tab control mechanism. Wing tips are attached by the same method as the leading

(Turn to page 57)

edge assemblies. All control surfaces are jig-built for interchangeability

The complete assembly of wheel, brake, brake flange, tire, tube, and axle on the new transport's landing gear is such that it may be quickly and easily interchanged; an automatic shut-off coupling in the brake line prevents escape of fluid when the brake unit is detached, making drainage of the line unnecessary, even when the parking brake pressure is applied Removal of either of the main landing gear wheels may be accomplished by detaching two bolts; the tail wheel may be removed by detaching but four bolts

In adhering to rule II that all parts of the Curtiss-Wright Transport requiring service should be accessible, we have achieved a new standard of equipment availability The centralized accessory compartment is located below the wing in the bottom of the fuselage where equipment may be easily reached by a mechanic standing on the ground and still be accessible in flight to a crew member who may descend to it via a hatch in the cockpit floor and the forward cargo compartment. Ground servicing is further simplified by our concentration within the spacious accessory compartment of such items as the hydraulic and electrical equipment, the de-icing and anti-icing equipment, the fire extinguisher and other accessories.

The unusual accessibility of all parts of the power plant installation is directly due to our application of the Curtiss-Wright Cowl, a type which emphasizes such maintenance features as simplicity, ruggedness and accessibility, and which has been thoroughly proved on our airplanes for the last four years Equally important are this cowling's operating advantages, reduced power plant drag and improved cooling control

This cowling is built in three sections, each extending over approximately one-third of the engine periphery The lower section is bolted to the engine mount and firewall, being designed to offer ample space for servicing the lower cylinders of the engine. Both upper cowl sections are hinged to the long, faired carburetor air intake duct which extends along the top of the engine compartment and attaches to the engine mount and firewall. The cowl is locked by quick action cam latches Without being removed, the upper cowls may be swung open, thus making the complete engine and engine compartment accessible for routine servicing For more extensive servicing, the three cowl sections may very easily be detached

While twin-row engine installations ordinarily require a complicated cowl flap of the multiple-vane type consisting of a large number of small flaps around the cowl skirt, which are operated by a somewhat involved mechanism, our engineers have developed a cowl flap arrangement of simple design which eliminates a number of parts ordinarily requiring adjustments Since the skirts of the upper two cowl sections fit tightly against the nacelle skin, all air is exhausted through an outlet at the bottom of the low cowl The air flow is controlled by a single large flap attached across the outlet, and is operated by a single control hydraulic jack

Recognizing that many serious structural repairs result from the development of cracks at points where local concentrated stresses build up, our engineers have followed rule III to avoid local stresses in fittings, at rivets and other attachments. We have thus eliminated for the airline operator a considerable source of wasted time and expense, especially since this type of damage often occurs at inaccessible locations

Elimination of this cracking is carried into the wing structures Whereas skin-cracking in the vicinity of the de icer attachment has presented a problem in the past due to the de-icer imposing load in the skin requiring a special reinforcement, we have installed wing de-icer attachments which are so constructed that the local oscillating stresses produced by the de-icers are distributed through a heavy gauge channel built flush into the nose skin, instead of being carried directly into the wing skin

Since the usual wrinkling of the skin under load because of its relative thinness or the rather distant spacing of the stiffeners, also contributes to the cracking of stressed skin wings, our engineers have developed a non-wrinkling design which eliminates the possibility of cracking due to stress concentrations and the working of rivets due to resultant tension loads This has been accomplished by using a heavy gauge skin reinforced by relatively light rolled Alclad hat sections, formed from the same type of material as the wing covering, providing the effect of a reinforcement of corrugated sheet with alternate corrugations omitted

This combination of heavy gauge skin and a short free span of skin between stringers makes serious wrinkling remote.

As a further precaution against skin cracking the skin is reinforced wherever wing or fuselage stiffeners terminate

In keeping with the wing design, the nacelle assembly offers many examples of good structural design from the viewpoint of maintenance; being built with unusually heavy skin, thoroughly reinforced so as to eliminate any cracking that might possibly be induced by the slightest residual engine vibration not absorbed by the dynamic suspension mount. Finally, the engine cowls are mounted on the engine mount and firewall rather than attached directly to the power plant, thus enabling the engine to vibrate freely within the cowling without the cowl oscillations which inevitably result in eventual fatigue failures. This type of cowl mounting incidentally contributes the improved appearance of a steady cowling in flight

Certain other advantages in structural design also merit description. In the cable control systems, where initial cable wear ordinarily occurs at fair leads, and any angle set in the cable at such points must inevitably aggravate the situation, fair leads are not used to change the cable direction more than one degree Of lesser importance, but nevertheless a major point in expediting service and repair, is the substitution wherever possible of elastic stop nuts for the use of castellated nuts with cotter keys.

Included also in the cost-reducing category is our use of plastic sheet rather than painted metal at points where there is considerable scuffing, as in the control room where interior appearance is preserved Similarly, the sills or frames of the large cargo doors are thoroughly reinforced with heavy gauge skin formed into a box section sufficiently heavy to prevent denting or damage in loading Finally, the floor of the cargo compartment is made removable in order to facilitate the repair of any damage resultant from the loading or shifting of high density cargo

The results of the engineering department's efforts to adhere to our policy (IV) of designing all individual details so as to reduce time and effort required for maintenance, reduction in operating costs and increase in profits, could be discussed at length. Three major developments, however, warrant detailed treatment: The new, independent heating unit, the fuel system and the unique instrument installation

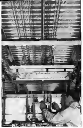
The airline maintenance expert who dreads the approach of winter because of aircraft heating problems, will enjoy learning that the Curtiss-

(*Turn to page 112*)

NEW SUB-STRATOSPHERE TRANSPORT

Controlled with American Tiger Brand Aircraft Strand and Cords

Making final adjustments on control cables. These cables are a part of the intricate system controlling ailerons, elevators, wing flaps and rudder. All control rigging is of American Tiger Brand Aircraft Strand and Cords.



MEET GOVERNMENT SPECIFICATIONS

American Tiger Brand Aircraft Strand and Cords fully meet the requirements of the latest U S Army and Navy Specifications. They are available in either tinned, galvanized, or U S S Stainless Steel in the following constructions:

19 wire Strand	semi-rigid
7 x 7 Cord	flexible
7 x 19 Cord	extra flexible

These products offer superior strength, fatigue resistance and minimum stretch. They are composed of uniformly cold worked wire, precision drawn to high tensile strength.

CENTER of interest in aviation circles today is the new Curtiss-Wright Sub-stratosphere Airliner, now undergoing flight tests at St. Louis, Mo This ship, a marvel of modern aeronautical engineering, is America's largest twin-engined transport It seats 36 passengers by day, sleeps 20 by night, and has a cargo capacity of 5200 pounds

Curtiss-Wright engineers have simplified the pilot's operation of this new skyliner by reducing the total number of flight controls 33 per cent, Another unique control feature is the "Tell Tale" device which automatically checks 50 major instruments and controls for the pilot.

These innovations call for control cables of only the finest types That's why you'll find this ship, like other outstanding modern aircraft, rigged entirely with American Tiger Brand Aircraft Strand and Cords Used in flying controls and engine controls of America's leading airplanes, these cables are a standard specification of successful aircraft designers and builders

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UNITED STATES STEEL

Action photograph of one of the Lake Erie Hydraulic Presses in Buffalo plant of Curtiss-Wright Corp.

and Curtiss is Doing It Better with

LAKE ERIE HYDRAULIC PRESSES

Lake Erie 400 ton Single Action Hydraulic Press with cushion installed in St. Louis plant of Curtiss-Wright Co.

Development of the new Curtiss-Wright Sub-stratosphere Transport is another example of how the dramatic progress of the airplane industry carries through from modern plane design to modern production methods and machines. Lake Erie Hydraulic Aircraft Presses in Curtiss-Wright plants are playing an important part in forming parts for the new Sub-stratosphere Transport as well as all other Curtiss-Wright planes.

Unmatched versatility for a wide variety of large and small parts produced in limited and volume production is speeding up output and cutting assembly costs through the use of wood, cast metal and other quickly made and inexpensive dies.

Fast operation, centralized control and convenient accessibility for synchronizing loading of stock and removal of finished pieces provide high hourly output.

Put it up to Lake Erie by writing an outline of your requirements.

LAKE ERIE ENGINEERING CORPORATION

General Offices and Plant Buffalo N Y
Sales Offices: New York Chicago
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John Inglis Ltd., Toronto, Canada — Fenwick S A., Paris, France and Milan Italy
Buck & Hickman, Ltd., London, England — L. Gordier & Co., Liege Belgium

AVIATION— RADIO

Dialing the Air Waves with Don Fink

Battery Units

Since the battery-operated portable receiver became a major item in the radio receiver market, it has been anticipated that a similar approach might be taken to aircraft equipment with worthwhile results. The initiative has been taken by Bill Lear and his associates in two new pieces of equipment, the AMR-1 receiver (which may also be operated as a manually-controlled loop direction finder, model AMRL-1) and the AMT-1 transmitter. Both are operated from self-contained batteries, and require no connection to an external battery of any kind. This makes them especially suitable for use in light planes.

The receiver uses five of the new low-drain battery-portable tubes, in a superhet circuit comprising an r-f amplifier, 1st detector and oscillator, i-f amplifier, 2nd detector, first audio and beam-power output. The intermediate frequency is 90 kc. The tuning range is 200 to 500 kc, and the batteries under normal conditions of use will deliver 150 hours of service. The sensitivity, considering the size of the receiver and the type of power supply, is remarkable. 2 microvolts for 50 milliwatts output. Selectivity is 60 db down at the edges of a 14 kc band, adequate for separating stations 3 kc apart. The overall dimensions are $5\frac{1}{2}$ by $6\frac{7}{8}$ by $7\frac{7}{8}$ inches overall for the receiver, and $2\frac{3}{4}$ by $5\frac{1}{2}$ by 7 inches overall for the battery supply. The weight of receiver, battery supply and headphones, is 9 pounds 9 ounces. The antenna and battery cable add one pound, 2 ounces, making slightly under 12 pounds for the total installed weight. A spare set of batteries weighs 5 pounds, 5 ounces. The receiver has been designed to operate satisfactorily over the range from —40 to +55 deg. C., and to withstand rigorous humidity and drop tests.

The transmitter employs a total of five 1Q5GT tubes which are 1.5 volt filament beam power amplifier tubes. One tube is used as crystal-controlled oscillator at any frequency in the range from 2700 to 6300 kc. A pair of tubes is used as a push-pull audio modulator to drive another pair in parallel as the power amplifier. Control of the transmitter, including the filaments is obtained directly from the microphone "push to talk" button. The usual audio range is employed, within 4 db from 250 to 2500 cps. The battery supply contains 90 volts of B, $1\frac{1}{2}$ volts of A, and $4\frac{1}{2}$ volts of C supply, respectively. The total installed weight, complete, is 11 pounds and 14 ounces. The dimensions are the same as those of the receiver. The battery life, under normal operation is about 100 hours. No power output rating is given (the manufacturer's rating on the tube, however, is slightly over one half watt in audio service, for a pair of tubes). The estimated range of the transmitter varies from five miles or more with a fixed "V" antenna, to 20 miles or more for a hand-reel antenna.

New Volume

Howard Morgan of TWA has written a new book "Aircraft Radio and Electrical Equipment" (Pitman Publishing Corp., New York, 1939, 374 pages, price $4.50) which fills a very definite need in the field. It combines an elementary approach to fundamentals with a thoroughly practical approach to existing equipment, both of which will be welcomed by technicians and pilots. The book is not written for experts (as too many books in the radio field are) but rather, in the author's words, "for many people connected with aviation who would like to know more about electricity and radio."

The first three chapters are concerned with fundamental concepts of electricity and radio. Throughout this part of the book, clever analogies have been drawn between electric quantities and their hydraulic analogies.

Transmitters are treated in two chapters. The first gives the fundamentals on which the operation and adjustment of transmitters depend, while the second contains complete operating and circuit specifications for 12 commercially-available transmitting equipments from 5 to 100 watts output.

The problems of propagation, fading, static, u-h-f horizon effects, etc., as well as the subjects of direction finding and u-h-f equipment are treated in separate chapters. The concluding chapter is concerned with inspection and maintenance procedures. The book fulfills its intended purpose, and it is a welcome addition to the current literature of aviation radio.

Battery-powered transmitter and receiver recently announced by Lear

The Birdmen's Perch

Back in December we promised to print an Honor Roll of those Perch fans who sent in solutions to a "tricky" (or so we thought) problem. We expected answers by the dozen . . . we got *hundreds!* The partial list below is only the beginning, next month we hope to print the balance We're mighty happy though somewhat stunned by the whole business *Congrats to all!*

**"Tattered Wing-Tips," Editor, The Birdmen's Perch,
Room 3800, Gulf Bldg., Pittsburgh, Pa.**

ONCE BITTEN . . TWICE SHY DEPT.

Below is a problem sent us by George W Prediger, of Valhalla New York If you'd like to know the correct solution, we'd be glad to mail it to you

Important, N B, Attention We will not contract to publish an Honor Roll on any problem from now on Forever No kidding Even if it has no answer You are much too smart The next time we would

probably have to move off the Perch to make room

At a recent air meet there were assembled 100 planes of three sizes

There was also a fellow whose mission in life is creating problems for Perch puzzle fans He had with him a supply of that original lubrication problem solver, Gulfpride Oil

To the pilots of the Class X ships, he gave ½ gallon

To the pilots of the Class Y ships, he gave 10 gallons

To the pilots of the Class Z ships, he gave 50 gallons

All in all he distributed 1000 gallons How many ships of each class were there?

DR. WING-TIPS' TASTY TONIC

Remember the sulphur n molasses days? Ever since our grandmother used to force the stuff down our throat, we've been in favor of nicer-tasting medicines for man, beast, and machine

Hence Dr Wing Tips Tasty Tonic—The Palatable Potion for Planes (also known as Gulfpride Oil) In developing this yummy panacea, the old Doc achieved what is also the world's finest lubricant The exclusive Alchlor process—which digs out up to 20% more nasty tasting sludge and carbon-formers—is probably responsible Anyway Gulfpride's the best prescription for any season—both for your plane and your pocketbook.

★ HONOR ROLL ★

Billie S Adams—C. M Dahlen—Walter L. Miller—Joe McKinarray—Charles M D Reed—Leonard C Todd—Thomas J O Hara Jr —Louis H Shornich—Gene W Biehen—Lieut Lynn Berentz—Charles W Wilson—Bill Maxson—Joseph Terek—J L Antic—Frank Barbera—Edward C Breinig—Warren G Furry—Russell F Hay—George F Kenny—Stanley Patrick—Robert Murray—Lyman Holmes—L B Howland—R C. Humphrey—J Stiles Owens, Jr —Marshall Newcomb—Jack Hipple—Ernest E Erickson—Lee Dover—Leon Wonka—Mrs Harold Walker—J Wistar Stowe—L. R Stockdale—John Messner—Wilhelm Bann—Rolla Keenan—C. E Juncker—C. M Jameson—Robt R Jewett—Donald Ingem—Evan H Schuerie—Bob Consaley—D O Siker—Stanley D Herbert—Edwin Sykes—James W Davis—Don McCash—James Norman—Albert Preuss Jr —Charles Phelps—J Howard Wilcox—Wiley Clayton—Walter B Hass—Thomas R. Cole Jr —Don C. Kish—Edward C. Blomeyer Jr —Kenneth Colville—F E Every—Bernard M Rose—Travis J Armstrong—Thomas S Noble—Marvin Weller—John Turner—Richard Smith—D W. Fraley—Betty Peuser—Bill Forberg—J R. Shoemaker—John Anderson—E Frederickson—Emmet O Laughlin—Elmer R Seifert—Ray K Rowe—Allen Rappen—T S Torreson Jr —Herb Wenn—George W Prediger—James C Schubert—Philip S Haiman—Albert J Laudh—P S McCulloch—Billy McDaniel—Walter E Maddy—Karl K Dimmer—Bob Chance—Edward Carney—Ralph T Argue—Jack Irving Weinstein—Wilber Wenler—F P Taylor—Howard Edwards—Philip Emilio—Henry Eisenberg—Earl Smith—Carroll L Greer—John Reinhold Jr —Glenn Englest—Leon Resnacon—Bill Champlin—Ted Higgins—John H Knight—Wm V Mirafield—Clifford A Wright—A Q Lundquist—Clarence Williams—Henry Winslow—Ward Prossman—Howard Shull—William L. Frambes—Jeanne Haylock—Marcell Jansen—Charles J Paine—Daniel Reyes—F W Shepardson—A C Fowler—Wallace E. Howell—R. F Jennings—Jody Brown—John C Babcock—Helen Lee—W Sterrett Pattison—Howard French—William White—Lowell Miles—Lyster B Comy—Dale Bassett—Quentin Evans—Ernest Gardner—Martin M Georges—A R Metcalfe—B Reiser—Jack Polkey—Henry B Fernald Jr —George Lindner—G P Thorn—A M. Scheerer—Ken Coward—R M Prine—Carl W Mumm—David Gramm—Leon Edelson—Vance S. Coleman—J W Stevens—Howard Burhams—E. G Davis—Vernon George Gross—Richard Hayworth—Hugh Nennmeyer—Herbert Beel—Harold Earp—John F Hedrick—Gregg Henry—Stanley Ward—Jack Dexter Wright—Bill Holloway—Ray La Master—Don Sutter—Donald C Stone—Dale Uppinghouse—N G Willen—Ted Hanna—Lloyd Porkert III—Robert Crouse—Curtis O Hanson—J Hendrick—Vincent D Hock—Charles Renn—Jack L Zane—Bill Carroll—Joe M Warren III—Laura Riggs—Floyd Adkinson—J E Baxter—Richard J Buchan—Dan Reed—Henry L. Harmon—John Wm Chrap—Robert Burgess—Wm B. Ames—John Jolly—Kermit E Hemminger—Anton Trykoski—Willard H. Dudley—C. Robert Brandt—Larry Gilbert—Herman A. Rinke—William Bernstein—Taylor D Johnson—Russell French—Everett G Bentta—Wm. Dean Noyes—Donald L. Thompson

THIS MONTH'S THUMBNAIL WHOPPER!

Dear T W T

Want to know why I never have any trouble solving your posers?

Don't tell but I always keep a cup of Gulf Aviation Gas at my elbow

Between us, one swallow of G A G will give anyone flights of the imagination!

Help! Ulp! Glug! Laura Riggs

BUYER'S LOG BOOK

What's New in Accessories, Materials, Supplies, and Equipment

An extremely compact, light weight aircraft engine pre-heater has been developed and introduced by the Harvey Machine Co , Los Angeles, Calif Known as the Vulcan Pre-Heater, the Harvey device should find wide application during winter months, and in northern latitudes A number of these units have been in use by Western Air Express since 1936 with uniformly satisfactory results. The Harvey pre-heater consists of a burning chamber, a stack leading to the engine cowling, and a hood to confine the heat within the cowling The stack telescopes to permit of easy transportation and storage Operation of the unit starts with turning on of the gas regulator Any easily available gas may be used for heat, the cost of operation being very low The pre-heater can be set up in ten minutes and will warm an extremely cold engine in about twenty minutes after set up.—AVIATION, *March, 1940*

Engine timing is simplified through use of a handy little gadget manufactured by the Aeronautical Trading Company of Floyd Bennett Airport, New York The instrument consists of a cast aluminum timing disk with a solid bronze pointer which has a pendulum weight at the bottom and a ball bearing roller in the center Adjustable screws permit clamping on any propeller hub or crankshaft in a few seconds The bright red pointer is easily read against the black dial, which is graduated in degrees.—AVIATION, *March, 1940*

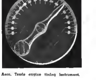
Developed for specialized applications where bearings are inaccessible for lubrication, or are subjected to sub-zero temperatures, a new type ball bearing developed by the Fafnir Bearing Company, New Britain, Conn , should be of special interest to aircraft people. The new Fafnir bearing incorporates ball bearings of a porous bronze impregnated with oil which lubricates the bearing adequately throughout its entire life. Test bearings which have been in continuous operation 24 hours a day for more than five years are still in satisfactory operation without addition of any lubricant In sub-zero applications, where even light grease will harden and cause extremely high starting torque, or stiffness in controls, these bearings provide a minimum of drag—AVIATION, *March, 1940*

An excellent example of the application of Neoprene to aviation design problems is given in connection with development of the Hamilton Standard hydromatic quick feathering propeller In this design the sealing problem was unusually difficult due to the wide variables encountered The seals must hold oil at pressures varying from 50 to 400 lbs per sq in , and under temperature conditions varying from —50 to 150 deg F Moreover, the seals are in contact with engine oil contaminated with fuel and combustion products Also, the seals must operate under varying clearances After exhaustive tests Neoprene was selected for this job and was applied to seven different sealing applications Two years of service testing has thoroughly demonstrated the success of the application—AVIATION *March, 1940*

With flying boats increasing steadily in popularity much interest has been shown in the McKinley Pneumatic Floats, Babylon, L I , recently given an ATC, and now being manufactured by the Goodyear Tire & Rubber Co of Akron, Ohio Model PF-2, weight 42 pounds each, was designed and approved for planes grossing 1475 pounds. This model is practical for ships as light as 1000 pounds gross Goodyear airship fabric is based on a foundation of 3-ply, long fibre cotton and treated with 90 layers of rubber Single rigid member is a V-shaped beam, eight inches wide on top and seven inches deep It is made of punched dural anodized and treated with zinc chromate. Each float has five compartments—AVIATION, *March, 1940*

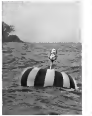
Means for over water flying at night are now available through development of a new seadrome contact light buoy by the Firestone Tire & Rubber Company and the Westinghouse Electric and Manufacturing Company, with the cooperation of the Civil Aeronautics Authority Having important naval significance, as well as aiding civil flying, the new lights are placed in lanes to mark a runway in a seadrome landing basin One of the features of this light is that it remains stationary which serves as an aid to the pilot when coming in to a landing The new markers, which are anchored permanently to the bottom of the water channel, consist of a new type rubber float which causes the light to remain virtually motionless under any normal movement of the water. The light is so diffused as to eliminate reflection from the surface of the water. The large rubber float also serves to guard flying boat hulls against damage in case of contact Power for the light is provided by a dry cell battery pack.—AVIATION, *March, 1940*

Harvey Vulcan engine pre-heater.

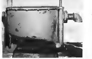


Aero. Trade engine timing instrument.

McKinley Pneumatic Floats on a Cub.

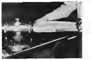


New Aid to Seaplanes



Gale Liquid Conditioner

Elastic stop spline nut



Freedman-Burnham propeller plane table

Designed to meet the problem of oil separating and cleaning for industrial plants generally, the Gale Liquid Conditioner, developed by the Gale Products Company, New York, is now being applied to oil reclamation in certain aircraft factories and field hangars. The Gale oil separator is a low cost simple apparatus, easy to install and operate. It does not refine or re-purify lubricating oils by refinery methods, but rather cleans oils and greases in a water bath and separates them from the water quickly and completely, making them available for use without the delay of settling tanks—AVIATION, *March, 1940*

Elastic Stop Nut Corporation has announced an expansion of its well-known line of lock nuts to include nine new types of nuts, all of which embody the basic Elastic Stop self-locking element, a resilient non-metallic collar built into the head of the nut The new nuts are designated as thin hexagonal, spline, internal wrenching countersunk, etc With variations in sizes, thread systems and materials, 160 new standard items are offered—AVIATION, *March, 1940*

A portable plane table for accurately setting and checking the pitch of adjustable pitch propellers has been introduced by the Freedman-Burnham Engineering Corporation, Cincinnati, Ohio Designated Model FBPT-100, the plane table has built in bubble levels, four adjustment screws, and may be used on any convenient work bench, desk or table The propeller is mounted on a mandrel at the center of the table and the pitch is read or set with a bubble protractor The table is circular in shape measuring 14 inches in diameter and 15 inches high Weight complete is 50 lb—AVIATION, *March, 1940*

Built to speed up stamping processes, the Cecostamp press is being manufactured by the Chambersburg Engineering Co of Chambersburg, Penna Air pressure supplies the power for this press, which has been used successfully for forming stainless steel and other hard-to-form alloys of low ductility, for forming thin, hot work that cools quickly, for embossing, and for short run work The short-run stampings can be handled inexpensively by using dies cast of lead and zinc in plaster molds Wood, aluminum and magnesium dies are also used. As cylinder bore is relatively small and as most operating strokes are short, use of air is economical—AVIATION, *March, 1940,*

Row of Cecostamps in the Glenn Martin factory

TURN and BANK Installation

In these days of instrument flying a Turn and Bank Indicator must operate properly. Correct installation is the primary step.

By Ray Snyder

President, Snyder Aircraft Corporation
Chicago

MANY operators and private pilots are under the impression that a Turn and Bank Indicator can be calibrated to show a 180 degree turn per minute, or 360 degree turn in two minutes, either one or two needle widths of the pointer, merely by advising a repair station of the air speed of the airplane. This cannot always be done for the following reasons.

1 The standard Turn and Bank venturi may be too small to produce sufficient suction for proper operation

2 The venturi tube may be installed at such a poor location on the airplane that operation is inefficient

3 The length and diameter of the line between the venturi and the Turn Indicator is an important factor and if not right may be a source of trouble

4 After the instrument has operated for a short period of time it is possible that the filter or screen of the air jet inlet may become clogged with dirt. This causes the instrument to be starved of suction and give an incorrect reading

If a Turn and Bank Indicator is to give correct readings it should be installed according to the following procedure: On all single engine airplanes with motor turning clockwise from the rear, the venturi tube should be installed on the left side of the fuselage or in some location where it will receive a smooth, uninterrupted flow of air. The venturi should be in a position as near as possible to a point three-fifths of the distance out from the center of the propeller hub to the tip of the propeller blade

The line for connecting the venturi to the Turn and Bank Indicator should never be smaller than one-quarter inch in overall diameter

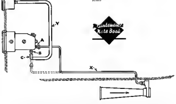
No hose connection or connection should be used that will restrict the internal flow of air passing through the line

A suction gauge should be used to check the suction. To do this the gauge should be installed in series with the Turn and Bank Indicator and the venturi by teeing into the line as near as possible to the Indicator. If the Indicator case has two openings one at the bottom and one at the rear, the unused openings should be employed

When this is done the airplane should be taken aloft and the suction gauge reading noted while the ship is cruising at the speed at which blind flying problems are usually worked. If three-quarters inch of suction is not received it is an indication that a larger venturi is needed. If a larger venturi is needed it is suggested that a Sperry venturi be purchased as it will supply all the suction necessary

In most cases the Sperry venturi will supply more suction than is necessary. This may be corrected by installing a simple metering jet between the instrument and the venturi. If too much suction is available, do not meter it below two inches as this is the most efficient operating point for a Turn and Bank Indicator

The chief information a service station requires for the correct calibration of a Turn Indicator is the amount of suction under which the instrument will be operated. Without this fact an instrument cannot be calibrated nor can it be guaranteed to operate within the limit necessary for working out blind flying problems



Turn and Bank Installation. If Turn Indicator has two outlets, connect venturi line X to fitting A and suction line Y to fitting B. If Turn Indicator has only one outlet, connect venturi line X to fitting B and tee suction gauge line Y at point C

. . . it's the Odds-on Choice by a Wide Margin

Seems like everybody's going TAYLORCRAFT

Listen to the talk of fliers who have flown and compared today's light airplanes. You'll quickly notice the extra enthusiasm — the more favorable comments for Taylorcraft. Discriminating people are amazed that such beauty, style and craftsmanship can he bought for so little money. It just seems like most everybody would rather own a Taylorcraft.

Take a trial flight yourself — see and feel the difference! You, too, will find that Taylorcraft handles more smoothly, more responsively, more surely, then any other low price plane. You'll surely praise its snappier pick-up, positive stability, all around superior performance. Yes, your own comparison will prove that Taylorcraft out-flies them all. It's the plane you'll prefer to fly and choose to own.

SEND FOR DESCRIPTIVE BROCHURE

The new 1940 Taylorcraft is available in 65-60-55 and 50 H.P. De Luxe models and the new Trainer with modern side-by-side seating and interchangeable wheel or stick controls.

$1495 and up
F.A.F. ALLIANCE

It's TAYLORCRAFT for 1940

AMERICA'S MOST MODERN LOW-PRICED AIRPLANE

★Take a Look! Take a Flight! Compare Taylorcraft and see the difference. Let us arrange an early demonstration for you.

TAYLORCRAFT AVIATION CORPORATION
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First on the land... and now on the sea!

ON OUR PAY ROLL...BUT HE WORKS FOR YOU!

To us, our salesman is *your* representative. We expect him to interpret your needs to us to obtain for you the benefit of our wide knowledge and experience so that your Westinghouse equipment will pay lasting dividends. He is on *our* pay roll, but he works for *you*.

TO ITS RADIO BEACONS AND LANDING FIELD LIGHTS WESTINGHOUSE NOW ADDS *"SEADROME CONTACT LIGHTS"* FOR SAFETY IN NIGHT SEAPLANE OPERATIONS

DESTINED to become an invaluable aid to all night seaplane operations, the new floating light marks another contribution by Westinghouse to American leadership in aviation.

This new and ingenious method of lighting, combined with a floating rubber "doughnut," allows the pilot to see the marker lights, as steady as if they were on lampposts. Deceptive shimmying lights on the water are completely eliminated, even in rough weather, and the rubber floats are unlikely to damage seaplanes while taxiing, taking off or landing.

Through every phase of the industry, you'll see Westinghouse developing new methods, new equipment, to advance American aviation. You'll find it worth while to call on the local Westinghouse office, for any electrical need.

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THE AVIATION NEWS

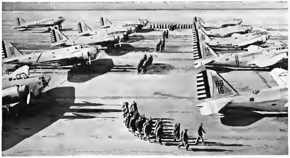
REVIEW COMMENT FORECAST

BLAINE STUBBLEFIELD Washington
C. F. McReynolds Pacific Coast
Jay P. AuWerter New York
E. R. Locbin New York

MARCH 1940

Government Walks into the Airplane Plant

(Story on page 90)



FIRST TIME IN THIS COUNTRY—the Air Corps transports troops in a military maneuver (above). The picture shows a battalion of soldiers from the 65th Coast Artillery, Ft. Barry, Riverside, after a trip of 500 miles in the Douglas B18's. Notice there is only one transport: the Douglas military DC-3. Hundreds of military men were moved from various encampments on the "Western Front" in the Army's sham war on the West Coast. **RIGHT: SOUTH OF THE BORDER** flight from New York to Mexico City. Meet some of them: William Beattie and **T. E.** Braniff, of Braniff Airways, are here. So are C. R. Smith, Willis Lipscomb, George Mace, and Charles A. Rheinstrom, all of American Airlines, who furnished the Flagship.

NATIONAL AVIATION

CAA Will OK Mileage

About 18,000 miles of new routes would be added to the country's air system in the near future if all applications for certificates (not counting duplication where more than one application is in for the same route) were granted by the Civil Aeronautics Authority. There is no doubt that a major part of the new mileage will be authorized. If so, the pressure for equipment and pilots will be still further increased.

TWA has filed for Pittsburgh-Boston

United has filed for Cleveland-Boston

Hearings started on the applications for a net work of parallel and competing runs between New Orleans, Kansas City and other points in the region by four companies: Braniff, Mid-Continent, Continental and Kansas City Southern. Eastern Airlines intervened and one of its motions to disqualify had been overruled as this was written

CAA examiners ruled that air mail service is not necessary on Penn-Central's Pittsburgh and Buffalo route, but authorized stops at Youngstown, Ohio, and Erie, Pa.

Hearings have been held before CAA on the application of Mid-Continent for extension of AM 28 from Bismarck to Minot, N D

National Airlines applies for Orlando-Jacksonville; certificate was recommended in examiner's report; Eastern Airlines' protest was heard by the Authority

Northwest Airlines has applied for extension of its line eastward to New York via Toronto, Can.

Money For Air Mail But Not For Ads

An increase of almost $4,000,000 over last year's appropriation for foreign and domestic air mail payments was approved by the House in the annual Treasury-Post Office supply bill. Of this amount, $686,800 goes for domestic air mail to make up a total of $19,331,000, and $3,164,628 to hike foreign air mail payments to $15,674,149

No provision was made for new routes not yet approved by CAA, in line with Congressional policy to withhold such appropriations until certificates have been issued

Of the increase for domestic carriers, $578,125 covers rate increases on several lines, $108,675 for increased frequency on existing routes, and a small augmentation of the Post Office air mail force

Higher trans-Pacific and South American rates, and inclusion of the New Zealand route on a full year basis, accounts for the greater Federal contribution to foreign air mail

Another $400,000 is expected to be granted in a deficiency bill later in the session on the President's recommendation to cover additional trans-Atlantic schedules

An item of $50,350 requested for advertising the air mail service was disallowed because "the American public generally is pretty well informed as to the existence and advantages of air mail"

Blind Landing Clash

Blind landing systems will soon be set up experimentally on ten airline cities to be selected from a list of 25. This step in progress toward eventual daily use of the glide-and-guide beams is being taken following tests at Indianapolis by the Civil Aeronautics Authority, and following recommendations as to the best system by the National Academy of Sciences. You will recall that the President called upon the Academy to settle the dispute and concentrate research effort on one system

The system at Indianapolis was built by International Telephone and Development Company, associate of I T & T and of the German Lorenz Aktiengesellschaft. ITD's bid of $64,870 was accepted against the bid of Air-Track Manufacturing Co., which was $82,116. ITD's contract called for a portable system, but CAA, apparently by later agreement, accepted a stationary installation. Air-Track then filed protest with the Comptroller General of the U S to prevent payment on the ITD contract, arguing that fixed units (as compared with portable) would not be in the public interest

CAA is prepared to reply that only one of the Indianapolis runways was useable for constant experiment, that stationary equipment is not greatly different from portable equipment, that research with fixed units gives better results, that portable equipment will be used in service.

Congress Pinches Dimes For Weather Reporting

Weather Bureau plans for increasing service to air navigation were halted when the House allowed only $100,000 of a total requested increase of $453,690 for all the weather services. The Bureau had hoped to devote almost a quarter of the additional funds to augmenting meteorological reports along Federal airways

More detailed weather information is thought necessary particularly in the western States, on the Pacific route to Hawaii, over the Alleghanies, and on approaches to New York

The disallowance will not leave enough money even to begin the proposed project

A total of $6,272,870 was approved by the House, all but $145,000 (administrative fund) for general weather service, observations and warnings. The amount required for the airways weather service was this year incorporated in the general total since the two services are becoming increasingly interdependent

Also refused was a sum of $250,000 for construction of the second unit of the Bureau's building in Washington

Jobs For Reservists

WASHINGTON (AVIATION Bureau)—The Air Reserve Association here is making experience records of its members and calling around on all branches of the industry, placing many in jobs. The members appreciate this service, and so do the employers. More jobs are being offered just now than the Association can fill. Employers are finding the Association a convenient clearing house; it's easy for them to locate the good men, who are scattered all over

Most of the men have desirable qualifications: they are pilots, engineers, radio men, etc. It's easy to place them on a staff, because their citizenship, education, health have already been checked up officially by the Army. Most of them are college graduates, nearly all have at least two years undergraduate.

The Association is headed by Pres Capt. Brintnall H. Merchant, and the national headquarters executive is Capt. Corley P. McDarment.

Headed for Town

WASHINGTON (AVIATION BUREAU)—The new management of the National Aeronautics Association is warming up and seems to be pointed toward town. A deal was under way as this was written for a new headquarters office in one of the downtown hotels, which would be open to the whole industry as a Washington stop-in place.

At its last regular monthly meeting the Executive Committee discussed (1) possibility of combining the National Air Races with an Annual Air Show, flight demonstrations, races and industry get-together; (2) methods of easy transition to the new structural setup of NAA; (3) budgets for NAA projects and forms of agreement for the various aviation organizations which will affiliate with NAA

Committee approved dates of July 7-8-9-10 for next annual meeting at Denver, planned to make it the first National Aviation Congress, planned a Midwest Airshow at Denver July 4-5-6. Next meeting of the Committee was set for March 8 at Washington, following meeting at Tulsa on April 28. Another Annual Aviation Forum will be held in Washington in late March or early April.

TWELVE NEW CUB COUPES lined up at Lock Haven for delivery to CAA. They are equipped for instrument flying and have a cruising range of five hours. CAA now has 21

Better Men Wanted

With the entire young male population wanting to be pilots, it seems strange that the Air Corps and air transport should both go begging for stick and rudder men! Now comes R. T. Freng, United's director of flying, calling for 70 co-pilots within three months, 200 in four years. Physical and mental qualification is the bottleneck.

The present pilot shortage is not nearly as serious as the pilot surplus will be later on if some restraint is not exercised. It should be remembered that the airline pilots make up one of the smallest and most exclusive clubs. There are about 1200 of them, total. Probably two or three hundred would meet this year's demand by the whole airline system.

Airline flying is getting to be one of the most attractive professions. It pays from $5,000 to $10,000 a year. And scientists are just discovering that the earning life of a pilot is around 30 years—20 to 50.

Aeronautical Archives

The most complete aeronautical library in the world is now housed at the New York office of the Institute of the Aeronautical Sciences. Known as the Aeronautical Archives, the wealth of aviation material was made possible through a loan of some 10,000 books, magazines, photographs, reports and clippings by W. A. M. Burden. This private collection has been added to the extensive technical library already owned by the Institute. Important part of the Archives is an index of over two million references, compiled by WPA under Major Lester D. Gardner's direction during the past four years.

In addition to the Burden collection, two additional collections of photographs, prints, air mail stamps and covers, medallions, trophies and relics of great flights have been offered to the Archives. Several thousand books will be immediately available to sustaining members who cannot visit New York

Major Lester D Gardner, Executive Vice President of the Institute, is President of Aeronautical Archives. Secretary is Elmer A Sperry, Jr., and Treasurer is Charles H. Colvin. W. A. M. Burden, of National Aviation, is Chairman of the Board.

Fast Waltz

The 100-kilometer speed record for light planes of 3rd category of 105.6 m p h was broken January 30th at Floyd Bennett Field, Brooklyn, by Edward J. Walz of Camden, N. J., who flew the closed course at 118.75 m p h in a Luscombe 65 stock plane.

BELL AIRCRAFT needed a Washington representative recently and after looking over the field made a smart move in appointing Fred Neely to the job. In aviation for 18 years with such people as the Washington Star, N.A.A., Bureau of Air Commerce and Gulf Oil, Fred knows the answers.

Contracts to second and third bidders on Army and Navy aircraft were authorized in a bill signed by the President.

Navy has set up officials in 12 key seaports to mobilize private shipping and aircraft in case of emergency

Reduction of Navy cadet flying time was proposed and Congress objected

Shortage of airline equipment may develop this summer if traffic increase continues

THE WASHINGTON WINDSOCK

by BLAINE STUBBLEFIELD

If Economies Works—Prices Will Go Down

Postwar airplanes prices will be down, if the laws of economics are enforced. Vast foreign orders for training planes will bring mass production never before realized. Trainers, like the North American 35, for example, are easily convertible to private use. Low airplane cost and other factors might bring air fares down to train rates. The public, then having no excuse but inertia for not flying, might climb aboard and the lines would really buy airplanes. And if J. Citizen could get a $8000 ship for $3500, he might buy it. The thousands now learning on light planes will want to graduate to larger ships some day

Engines would have cost more if both radials and in-lines had been in equal production all this time. Mass production of radials for both civil and military markets reduced the cost, made a profit, and probably contributed to development. Engine dependability is a remarkable achievement. It seems only yesterday that our instructor was telling us never to fly over a patch of timber

Less privacy for private crashes is what you can expect, because CAA is turning a grim eye on non-scheduled accidents. "Reliable sources" have told this column nothing, but you can see how the Safety Board went after the Louisiana affair. For the first time, the government has the personnel and the dough and the prestige—built up by the transport safety record—to go out and do a job. If you must crash, break your neck and save yourself a lot of trouble

Radial diesels are going the rounds of engine gossip. The story is that diesel radials, used to some extent in tanks, are in the works for aircraft. NACA has experimented with them, still does. Navy is watching with interest. But large application for military or commercial operation is not yet imminent

You know all along, of course, that air transport counts the same passengers over and over to make impressive statistics. Well, private flying does the same thing, with reverse English. From 1931 to 1936, first sale of personal airplanes totaled 15,000, yet the number of private owners increased only 300. This means, unhappily, that most of the few who buy airplanes don't keep them or buy again. CAA chairman Robert Hinckley told about this

DuPont's pickup system flew every day in January. Which is interesting because it was "contact" flying, a technique of fond memory to older mail pilots. CAA is whipping up some regulations for the pickup type of service, but probably will not pull the ceiling down over its ears. Piloting by railroad and river was a great institution. It may come back in style when your Aunt Lena and cousins all get helicopters

Grapes of wrath are stored in some aircraft building regions, say labor leaders here. Manufacturers, according to labor, are taking advantage of war boom talk to attract seads of workers and beat down wages, after the manner of California fruit growers in the famous book. Unions insist thousands of trained mechanics are unemployed while industry and War Department cry shortage. Why don't they get together and add up their figures before somebody swings a bilbo on somebody?

Attentio-o-o-n! Any cities that might want the NACA engine laboratory step forward four paces. Company—halt!

Calling Names

Ralph L. Heininger, District Sales Manager of Chicago and Southern Chicago office has been appointed assistant to the vice-president in charge of sales.

J. O. Urquhart and Hayes Dever have been appointed as assistants to Eran-Centrale vice-president J J O'Donovan in charge of Traffic and Fred R. Crawford executive and secretary.

Wilson W. Browe, recently secretary to U S Senator Josh Lee of Oklahoma, has been appointed to handle publicity, air mail and express for Mid-Continent.

M. C. Norberg recently was elected president of Electric Storage Battery Co. Born, educated in Sweden came to the United States, became engineer and finally president of Willard Storage Battery.

Edgar F. Odenwalder, former sec-treas of Marquette Airlines appointed comptroller of Canadian Colonial.

James Winchester, from American Airlines is now Canadian Colonial's publicity man.

Kermit R. Hatt goes pilot for Eastern. As a boy he barnstormed six public schools in Maine and later did the state by airplane.

Squadron Leader James R. Addams, Royal Air Force liaison officer for Britain on airplane orders placed in Southern California, is appointed Wing Commander equal to Lieut Col in U S Air Corps. Addams' office is with Lockheed.

Harry L. Mitchell, formerly of Air Associates has been named secretary treasurer of General Aircraft Supply Corporation.

Albert E "Pete" Blomquist, five years director of display for Eastern Air Lines, is appointed airport engineer.

Edward E. Emerson, recently a district sales manager of Babcock & Wilcox Tube Company, previously Jones & Laughlin Steel and Air Reduction, becomes general manager of sales for John A Roebling's Sons Company, Trenton.

Maxwell Eitles, Los Angeles, news writer goes to the publicity staff of Lockheed, Burbank.

Harold R Swanton becomes vice president of Precision Bearings Inc., Los Angeles, O F Wilson president announces. Swanton will direct company business in 11 western states.

Alfred E Ross becomes western sales manager for American Air lines office at Los Angeles replacing **Arthur Boggs,** who becomes district sales manager for the Ohio Pittsburgh area, offices Cleveland.

Thomas H. Bothwell, Georgia Tech '35 joins the pilot staff of Eastern Air Lines.

T T Hildebrandt, of long experience in airplane sales and promotion, is appointed Washington representative for Jacobs Aircraft Engine Co.

George E Warren joins Fleetwings, Inc. of Bristol Pa as factory engineering representative after long experience in aircraft manufacture.

William F. Palmer, formerly with Edward G Budd then assistant secretary to Kellett Autogiro, becomes secretary succeeding R. C Kellett who continues as vice president and treasurer.

Postal Digest Company, 11 West 42nd Street, New York published a Foreign Air Mail Guide $1.50 a year.

William L. McGrath, v p of Bendix is reelected president of Elmira Searing Corporation.

M. H. Kuhl is appointed assistant manager to the Industrial Division Timken Roller Bearing.

Arthur Curry, Illinois Aeronca rep. flew a "Chief" out of a snow-bound field with serum for a sick child.

Capt. E. V. Rickenbacker believes Eastern Air Lines is first to sign air travel contract with a baseball organization.

Cecil A. Ross is appointed chief of CAA's reference and research section under the director of statistics.

Eastern Air Lines second time in history and second consecutive month, flew over 11,000,000 passenger miles.

Braniff Airways will operate a third schedule between Chicago and Dallas beginning March 1.

"Douglas Airview"

Effective with the January, 1940, issue, the "Airview" magazine, formerly published privately for Douglas Aircraft Company employees, has been taken over by the Douglas company and will be published in future by the Douglas Department of Public Relations, under the direction of A. M. Rochlen. A statement issued by Donald W Douglas says, in part. As the "Douglas Airview" it will be published in the future by our Department of Public Relations. All paid advertising will be discontinued, but announcements of service to our employees, our industry and our communities, state and nation, will be given space. . . ."

On Organized Labor

A story that CIO is trying to entrench itself in aircraft manufacturing via the federal apprentice training system finds no confirmation. Apprentice Committee of the Labor Department is unaware of such a move however, some plants may hesitate to adopt the federal standards because approval would be by a state agency tied in with organized labor. Such fear, they say, is unjustified.

DEFENSE

Congress Trims Defense

The economy wave in Congress is gaining strength as annual appropriation bills begin to pass through the legislative machinery. So far the trend is for the House committee, originating point for spending, to undercut requests for funds, a practice even more intensively pursued by the Senate which is slicing further into budget estimates.

Even the popular national defense items are not safe from the paring knife: the House allowed the Navy only 352 of 570 airplanes requested in the annual Navy appropriation bill—a cut of over $21,000,000. Of the 352, 305 are replacement aircraft for the regular Navy, 47 are expansion planes for the Naval Reserve. Other reductions include $6,075,000 in the supplemental deficiency bill for 81 Navy scout bombers and $1,689,000 in the 1941 Treasury-Post Office supply bill for airplanes in the Coast Guard's neutrality patrol.

The latter two bills, however, do provide the Navy with $28,681,000 for 437 planes, the Coast Guard with $600,000 for planes.

The Navy supply bill as passed by the House provides $40,083,400 for aircraft, parts and accessories; $44,412,800 for maintenance of air bases, overhaul of planes, aviation clothing, etc., including $7,500,200 for experimentation and development; $1,206,500 for navigational, radio and other equipment; and $8,064,000 for construction work at Midway Island, Coco Sola, Alameda and Pensacola. (Harbor improvements at Guam to aid commercial air traffic were defeated on the House floor.) In addition, contract authorization of $10,000,000—instead of $20,000,000 asked—was granted. Another $3,985,342 is provided for aviation equipment, material and fuel for the Naval and Marine Corps Reserves.

Although Army Air Corps plans have not yet been revealed, it is expected the annual War Department appropriation bill will contain only such funds as may be necessary to complete the present expansion program. Great interest is centering on development of improved anti-aircraft devices and the new air raid warning system which may lead to expansion of the educational order program.

Meanwhile the Naval Expansion bill—an authorization to increase the Navy, not an appropriation—has dwindled to a 2-year, $655,000,000 program. Under this authorization, the Navy estimates it can purchase 1,011 new planes for $100,000,000 to achieve a top strength of 4,500 as set in the bill, including 500 for the Naval Reserve. Lighter-than-air craft authorizations were reduced from 36 to "not more than 12", allowing the addition of 4 new blimps at $150,000 each. Walsh-Healey labor standards and Vinson-Trammell 12% profit limitations are specifically applied to the program. This bill is yet to be acted on by both houses.

High Wing Bomber

The Army's new Consolidated bombardment plane, XB-24, has just made its initial flight at Lindbergh Field, San Diego. It is powered with four Pratt & Whitney 18-cylinder twin-row radial engines rated at 1200 h.p. each. Propellers are Hamilton Standard three-blade hydro-

PRESTO! AN AIRCRAFT CARRIER! This luxury liner, on which the Maritime Commission has called for bids, can be quickly converted into a Navy plane carrier by stripping some gear off the top deck, extending that deck, and burning out the uprights out of a lower deck which becomes a hangar, and installing an elevator. Two of them will be built for operation by a Pacific line. Largest ships ever to be constructed in an American yard, they will be 759 feet overall, 98.2 ft. beam, 35,000 tons, 24 knots. Stacks are on the starboard side. Of course the ships will have no armor plate.

ONE OF THE CLEANEST SHIPS to come out of a factory recently is the Vought-Sikorsky XSO2U-1, a two place, midwing, convertible type monoplane. It has a 12 cylinder Ranger air cooled engine developing 450 h.p. Resistance welding and flush riveting is used on external surfaces.

matic constant speed, 12 feet in diameter.

The XB-24 is a high-wing type, all metal construction, full cantilever high aspect ratio, with tractor nacelles mounted flush to the upper surface of the center section. Fowler type flaps extend inboard from the ailerons.

Reverse Airship Policy

WASHINGTON (AVIATION BUREAU)—This country's civil and military aviation should take another whirl at lighter-than-air. That is the brief meaning of a report just submitted to the Navy by a special board of experts. The report recommends (1) that Navy build a 850-ft. dirigible; (2) that it build two to four blimps a year for scouting; (3) that huge dirigible plane-carriers might be practicable in future; (4) that industry, the Maritime Commission, and CAA be encouraged and supported in lighter-than-air development.

Alaska Takes 2 Bases

Sites for two new Army air bases in Alaska have been selected one at Fairbanks and one at Anchorage. The last Congress appropriated $4,000,000 to begin work on the Fairbanks field, but funds are yet to be appropriated for the other.

Construction will begin at Fairbanks within a few months. This field will be used primarily for cold weather experiments.

Six Balloonatix

Navy is about to get authority to build lighter-than-air equipment, and now is going to train pilots. A class of six students will be started at Naval Air Station, Lakehurst, N. J., about the first of July. Applications are wanted by April 15. Officers of the classes of 1936, 1937 and 1938 are especially welcome. All applicants must enclose the endorsement of a flight examiner for lighter than air.

New March Field Units

Four new flying units of the First Wing, GHQ Air Force, have been organized at March Field, Calif., as part of the Army Air Corps expansion program. They are the medium-range 89th reconnaissance squadron, the headquarters squadron a 28th composite group; the 38th bombardment squadron; and 23rd air base squadron. Transfer of many officers and enlisted men is involved in formation of the new units.

Airacobra Strikes

Military airmen seem to rest easier since announcement of the Airacobra, which they say actually does the 400 m.p.h. claimed for it. There's so much fudging and bragging and secrecy, the world around, about military planes that you don't know whether the speeds they tell about are diving or level, loaded or empty, in the air or on some designer's slide rule. Army has been talking about 500 m.p.h. for a couple of years. Apparently it has no such animal on wings as yet. Nor has any other country, if the experts know their facts. They are glad about the Airacobra because they say it matches any fighter anybody has anywhere.

Who Saw first in the Army?

AVIATION, reporting the death of one Maj. E. H. Wilson, fell into errors on this question. This is the dope, right out of the Air Corps book. Fred E. Humphreys and Frank P. Lahm, on October 8, 1909, flew the first equipment purchased by Army. First officers commissioned as "military aviators" were: Gen. H. H. Arnold, Capt. Paul W. Beck, Col. Thomas DeWitt Milling, and Col. C. DeForest Chandler—all on July 5, 1912.

AVIATION ABROAD

Dissecting a Heinkel

When the British brought down a Heinkel He-111 bomber practically as good as new in Scotland last year, they started right in to dissect it. Some of the results are beginning to come to light now, and while the details of its bullet-proof gas tanks have got most of the publicity, the dope on the direct fuel injection system used on its Junkers Jumo 211A engines was probably the most important.

These engines, rated at 1,050 hp. at 2,300 crankshaft rpm at 14,000 feet, are liquid cooled inverted V-twelves equipped with two speed superchargers. The centrifugal supercharger is mounted to one side at the rear end with its axis at right angles to the crankshaft, and is driven at either 7 863 or 11 375 times crankshaft speed by two sets of gear trains For high speed the pilot engages a disc clutch on the high ratio drive gear, while the low ratio drive gear, which is connected to the drive shaft through an overrunning clutch, free wheels.

The throttle is located in the air intake pipe just after the supercharger, and has an automatic control operated by the boost pressure in the intake to keep it from being opened too far by the pilot's throttle control, doing away with the possibility of some ambitious boy's burning up the engine by opening it out at too high manifold pressures. The air enters the cylinder through two intake valves in the head, between which the fuel injector is placed in the side of the head. The two spark plugs are also in the side of the head, one at about 45 degrees and the other at about 135 degrees from the injector The single exhaust valve is in the head on the side opposite the injector

The chief point of interest is the fuel injection pump, and particularly the complicated automatic mixture control that proportions the amount of fuel injected to the weight of air taken in All the pilot worries about is his throttle and blower ratio control; the automatic control on the fuel pump does all the rest The injection pump is a twelve-cylinder plunger pump with two opposed banks of six cylinders. The whole works is mounted in the V of the engine, the plungers being worked one direction by a camshaft running half crankshaft speed and being returned by springs The fuel is injected into the cylinders in a fan shaped spray on the suction stroke, always starting at the same point in the stroke but being cut off according to the amount of fuel being injected

Each pump plunger has a spiral groove along the side at its head end working across a bypass port in the pump cylinder With a constant stroke the plunger will deliver a variable volume of fuel into the injection line through check valves according to how it is turned in its cylinder The rest of the fuel displaced by the plunger goes down through the groove, out the bypass port, and back to the suction side of the pump The six plungers on each side of the pump are rotated together by a rack across them.

British Press Combine

IN THESE DAYS OF HIGH-FLYING BOMBERS, Royal Air Force gives its men careful instruction in bomb sighting. Pupil is equipped with compass, bomb sight, air-speed recorder, etc, and watches horizontal screen below on which is projected a moving landscape Height speed and drift are controlled by pilot who sits beside pupil.

JUST TO LET ALL OF CURLEY VEENENDAAL'S FRIENDS know he got back to Holland all right. After serving KLM in U.S. since 1931, he was promoted to be Chief of KLM's technical organization. Left: one of KLM's American pilots Louis Gravis.

Preparing for the Junkers Ju88

Now that the British are pretty well used to being visited by assorted Heinkels and Dorniers, the Junkers Ju88 is being mightily talked up as something to get ready for. This is being done both by those in the government who don't want the public to get the idea that they are too safe, and by those in the trade who would like to see their own country turning out more bombers like it and plenty of fighters capable of catching it without trouble. So far it hasn't put in an appearance anywhere, but from the records it set last summer it must be quite an airplane. Just how the record ship compared with production models is a deep German secret, but at any rate it turned in a speed with 4,400 lbs load of 321 mph. over 625 miles, and 311 mph. over 1,250 miles

It looks nice too, it's a low wing all metal job of fairly conventional appearance except for the trick tail, which has a big fin and rudder in the middle and two smaller fins at the ends of the stabilizer. Another novelty is the type of radiator and cowling for the engines It has two Jumo 211 engines, and these are provided with a doughnut shaped radiator with the engine in the hole in the middle, the whole works being covered by a round nacelle and ring cowling like that used with a radial engine.

The gross weight of this ship is supposed to run around 17,000 lbs, which would put its wing loading at around 33 lbs. Like other recent German bombers, the crew of three are carried well forward, all together, instead of being strung out along the fuselage, and not much armament is provided. There's a gun above and one below to the rear, both in the small transparent bullseye type of mounts that the Germans are going in for instead of turrets.

Those Messerschmitt Destroyers

Another German ship that's come in for plenty of publicity on both sides lately is the Messerschmitt Me-110 Just what to call it is a problem, the Germans

AS OTHERS FLY IT

Propose Scandinavia-U. S. Line

Annual reports now coming out from the British aircraft industry show lots of work on the books but stockholders expecting boom dividends were mostly disappointed. Pre-war parliaments heard plenty of complaints from the opposition about excessive armament profits. In the past year or so the Air Ministry has been trying to keep profits just high enough to have plenty of money come into the industry for expansion, but not to let them get big enough to create a political smell. As orders expanded the rate allowed has been whittled down, and on the first of this year a new agreement between the Air Ministry and the Society of British Aircraft Constructors came into effect that cuts it a lot more. An extra tax on armament profits has been taking its slice of income, too. Short Brothers' profit of around £120,000 last year was way under the previous year's. Fairey Aviation with £248,000 was also down some. Rolls-Royce, which has given up its automobile business and is now turning out aircraft engines only, passed up its usual year end dividend pending agreement with the Air Ministry over details of payments. Hawker-Siddeley, the largest group in the industry, made £811,000, up only a little from the year before although assets and production had skyrocketed. One result of profit figures like these has been a hard drop in stock prices in the last year; issues of old established companies with huge backlogs have fallen as much as 50%. A new trans-Atlantic combination has appeared on the scene, pushing for a Scandinavia-U.S. line via Iceland and Botwood. It would be jointly owned and operated by D.D.L. of Denmark, A.B. Aerotransport of Sweden, D.N.L. of Norway, and Aero O/Y of Finland. They've sent a mission to the U.S. to apply for permits and also to look around for suitable equipment for a mail-only service. Right now the Scandinavian countries are busy pouring every cent they can scrape up into military preparations, which may hold up the airlines' fine plans. The British have announced that they'll reopen their North Atlantic line this spring.

Goering's birthday was celebrated this year by the Lilienthal Society for Aeronautical Research, which handed out three Lilienthal Memorial Medals on the occasion. One went to Kurt Tank, chief designer for Focke-Wulf, for his work in aircraft design and construction, and particularly for his job in turning out the four motored Condor. Another went to Dr Heinrich Klein of the Rheinmetall-Borsig armament company for work on aircraft armament. The third was given to Dr Friedrich Seewald, both for his scientific work and for organizing and directing the D.V.L. laboratories at Adlershof.

A new aeronautical record of some sort was certainly set in the French defense budget for 1940. More than 40% of it goes to the air force, a good bit more than to either of the other services. In nice round numbers the air appropriation is 106,000,000,000 francs, which works out at about \$2,400,000,000. That's a lot of money in anyone's language. One governmental move that has the French guessing as to its effect is the decree doing away with the Civil Aviation Department of the Air Ministry. At the beginning of the war a Department of Air Transport was set up in the Air Ministry to run the airlines, and Louis Allegre, director general of Air France, was put in charge. Mr. Allegre and his department are now put under the Transportation Department in the Ministry of Public Works, although they apparently are to keep some sort of a tieup to the Air Ministry. Those who might be afraid of the airlines being neglected by being stuck in with everything from railroads to barge lines, are counting on Mr. Allegre to look out for their interests, but there are a lot who figure that this move means that all French civilian flying, with the exception of scheduled lines, will be definitely shelved for the duration.

THE JAPS HAVE A YEN FOR RESEARCH. Not to be outdone by any of the other countries the Japanese have planned this super gigantic research center costing 200,000 yen. Notice the wind tunnel at the left, must be for testing clippers.

have given this class the name of "destroyer." Essentially it's a high performance, heavily armed multipurpose type. In Poland it was used on attack missions, is being brought out now and again in the West as a defensive fighter against British bombers, and it could probably be used as an escort fighter over medium ranges in a pinch.

It's a fair sized airplane, and going by the dimensions its gross weight has been estimated at around 15,000 lbs., which would figure a wing loading in the neighborhood of 36 lbs. Most of the Me-110s are supposed to have DB601 motors, which are rated at 1150 hp at 16,000 feet and have such features as direct injection and hydraulically driven, automatically controlled superchargers. Others may be coming out with Junkers Jumo 211 engines. In either case, two of them put out plenty of horses for a ship of this size, and the top speed is up in the 370 mph. range.

It is a nice clean-looking, low-wing ship, the Germans don't seem to have taken as much to the midwing arrangement as other countries have. The general effect is somewhat spoiled because the Germans have evidently not made any effort to retract or fair in the tail wheel, which hangs out in an aerodynamically shameful fashion. It's all metal, of course, and has the usual Messerschmitt single spar wing. To help the boys get it down, automatic slots and slotted flaps have been provided. The tail has twin fins and rudders.

Gas capacity is around 400 gallons, which with all that power doesn't give it any super range. It could make a round trip bombing escort flight to Britain by easing back the throttles, but it wouldn't be able to spare gas for very much fighting along the way. These ships seem to be coming out with a variety of armament, but outside of a movable machine gun or two to the rear on top, the main punch is fixed and fires forward.

KLM and the War

What the war did to K.L.M.'s traffic figures is shown by a report comparing the prewar eight months of 1939 with the last four wartime ones. In the first eight months about 88,000 passengers were carried, but the number dropped off to around 10,000 for the last four. On the East Indies route the Dutch were patting themselves on the back about their traffic increase to 5,000 passengers up to Sept. 1 compared with 3,500 for the same period in 1938, but from then on to the end of the year only 1,200 more were hauled. There's talk that the fare on the East Indies route, which was boosted considerably at the beginning of the war to help cover the big jump in operating costs, may be cut to get traffic figures up again.

In Europe K.L.M. has sent a survey ship through from Amsterdam to Portugal via Britain and Spain. On its schedule are flights to the Cape Verde islands, the next step on the trans-Atlantic route to Pernambuco, and also to Naples, still the western terminal for the East Indies line. The Dutch aren't saying whether they're working toward Netherlands-Britain-Portugal service, but this would permit tying up both their trans-Atlantic and East Indies lines to Amsterdam by air instead of having them end off short. The chances are that the British would allow the line—subject to several carloads of restrictions—as they could use a service down that way. At present they themselves are pretty well held back from starting the route, what with having their hands full elsewhere and not being on too good terms with Mr. Franco.

AVIATION PEOPLE

THOMAS E. CORPE is newly appointed general sales manager for Vega Airplane Co., Lockheed subsidiary. For past seven months he has directed Lockheed's successful promotion campaign and he will continue to handle such work, as well as put on a merchandising program for the Starliner.

T. C. SULLIVAN LAST MONTH became Secretary of Vultee Aircraft. For the past five years he has been on the Wall Street Journal, where he headed the aviation and automobile departments. Now 35 years old, he began newspaper work in San Francisco in 1927, after graduating from Berkley.

W. A. M. BURDEN, generous loaner of priceless aeronautical collection to the Institute of the Aeronautical Sciences, whose loan of 10,000 books magazines, photographs, reports and clippings when added to Institute's previous library forms the Aeronautical Archives, world's largest aviation library

TWA'S TRAFFIC AND SALES on the West Coast are now being run by Art Stewart, recently appointed Western Manager. In transportation business for 30 years, he has a wide experience. He must know a lot of folks as he sends Christmas cards to 9,000 people, all his friends.

AL. REED, LEFT, BOEING TEST PILOT, AND EDMUND T. ALLEN, Director of Flight and Research for Boeing, discussing the results of a test flight, in the cockpit of the Boeing 307 Stratoliner. The big ship is now being put through its paces by CAA inspectors Following tests the Stratoliners will be delivered to Pan American and TWA. Inaugurating 4-engine equipment on domestic airlines these ships should play an important role in the travel rush to the airlines that is expected this year Stratoliners will be first "upper level" ships for commercial uses.

AFTER TEN YEARS in the private airplane field, Al Le Fevre moves up to become Sales Manager for Akron Aircraft. In the new Funk airplane, Al believes he really has something to sell and he ought to know because he has flown all the Funks from the first "X" job down to the latest model.

NEW SALES MANAGER for the Austin Company is George W. Pielsted. Already a company vice president and formerly West Coast manager, he moves to Cleveland to handle sales for the entire company. He is well known for having built some $50,000,000 worth of industrial plants.

AVIATION MANUFACTURING

Enter: The Government

WASHINGTON (AVIATION BUREAU) It became clear last month that the U.S. government is getting ready to give every encouragement to rapid expansion during the coming year of aircraft production—with one eye on our own national defense and the other on helping Britain and France to fight the war These efforts revolve—rather to the disgust of the War Department—around Secretary of the Treasury Morgenthau, who has been given the triple responsibility of coordinating allied purchasing, rationalizing U.S. production, and seeing that tax policy puts no brakes on expansion.

Military and political importance of this program is obvious when it is realized that on the basis only of expansion now underway, our aircraft production by yearend will be nearly 2,000 units per month—equal to the most reliable optimistic estimates of German capacity The exact extent of the new plans is not known. But persistent rumors of orders nearly tripling the present $650,000,000 backlog, all to be delivered within 18 months or so, indicate that production will have to go far above the 2,000 figure. This would put us far ahead of any other country and make us indeed the aircraft armory of the world.

Morgenthau's first move toward smoothing out the flow of aircraft production was an attack on the engine bottleneck. Big problem here has been inability to get machine tools; Pratt & Whitney, for instance, have been getting delivery on only about 25 per cent of their orders The machine tool industry has been swamped with orders, foreign and domestic, and, made up of hundreds of small units, has been handling nearly everything on a first come first served basis

The Secretary summoned to his office representatives of the machine tool industry and the engine builders and, according to the official version, sat back and let them thrash it out Anyway, they walked out of his office with the makings of a priority system to give airplane engine manufacturers first call on tools.

The system adopted calls in general for allocation of at least 50% to 60% of machine tool capacity to domestic orders In addition, actual increases in production are to be attained, in some cases, through farming out of tool parts and through some installation of new machinery

This rather mild degree of rationalization of production is not likely to satisfy the allied purchasing agents Their idea, it is understood, is for all manufacturers to concentrate on the models of about three companies, with other companies arranging to share the orders Stricter organization of the industry is not unlikely, but chance that it will take this form is slight. The U. S. military are a hard-headed bunch, and no matter who pays for it, they aren't going to see our productive plant warped away from our needs

Taxation and profit-limitation policies raise no serious obstacles on expansion for domestic warplanes Closing agreements provide that special equipment, otherwise unusable, can be charged as a cost in figuring the profits under the profit-limitation clauses of the Vinson-Trammell Act and also for tax purposes. And even standard equipment, purchased for the fulfillment of the Army contract, can be depreciated at the rather favorable rate of 10% a year.

Expansion for military export is somewhat different. All this expansion is being paid for directly by the foreign purchasers. In fact the Allies are quite aggrieved because—ever since Pratt & Whitney, with Europe begging for engines, made the buyers pay for its 50% expansion—every manufacturer is insisting on a free plant Usual procedure is for the British or French to loan the cost of the new plant to the manufacturer. The loan is charged off, as deliveries are made, out of deliberately inflated prices

If the Treasury wanted to be nasty, of course, it could treat this transaction as a gift and tax accordingly Actually, the Treasury will take the deal at its face value The department has already made a ruling, in the case of the Atlas Powder Co., that such money "will not constitute taxable income to Atlas for the reason that such a transaction would be a loan evidenced by a note"

Meanwhile, for tax purposes the manufacturer can depreciate his free plant at the usual rate, just as if he had paid for it And if at war's end he can't sell his product he can junk the plant and write off the un-depreciated value in that tax year By junking the plant he can claim a loss in that tax year equal to the undepreciated value of the plant

Six Spartan Sales

H Warren Holladay, Sales Manager for Spartan, announces that six Spartan Executives have been sold since January first. Standard Oil of Ohio bought its second Spartan, having bought its first in 1938 John Thompson of Thompson Equipment Co., Spartan distributors for the Northeast, also bought a new ship

Holladay flew his Spartan demonstrator from Tulsa to New York in seven hours and had to go through plenty of dirty weather He tells us when more business men realize the time they can save in a fast ship, Spartan won't be able to keep up with orders

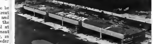
FRANK DE GANAHL, new President and General Manager of the busy Fleetwings organization, replacing his brother Carl, now Vice President in charge of research and development

Northrop Production

In the battle to keep its staff at a constant level by having construction of its new plant and design of its first airplane come out even, Northrop Aircraft is aided by current boom conditions First unit of the new company's Hawthorne plant was ready just in time to provide mock-up facilities on the first model The whole plant was finished early in February, before production could start, but at that point Northrup produced its ace in the hole and the plant is now busy producing assemblies for Consolidated Aircraft of California under a $600,000 subcontract

North of the Border

Although the famous rope across the border is well on its way into American mythology, delivery of warplanes to Canada is not as complicated under the Neutrality Act as you might assume. The eight Lockheed bombers delivered to Canada since the war began have been flown to Pembina, N. Dak., by Lockheed crews, with payment made while the ship is en route At Pembina, the crew pushes the ship across the border, climbs back in, and flies on to the Canadian delivery point. Ships of other companies, it is understood, have been flown by Canadian crews while in Canada; no foreign crews have operated American planes in the U. S., Aeronautical Chamber of Commerce says.



Wide World

THOSE NEW ORDERS BREWSTER received forced a move to larger quarters The firm has taken this large hangar at Newark Airport thus bringing a new kind of activity to the field

Harlow's Canadian Rights

J B Alexander, president of Harlow Aircraft Co., has announced signing an agreement with R. L. Gibson, president of the Cub Aircraft Corp., Ltd., of Hamilton, Ont granting the latter firm the Canadian manufacturing rights to the Harlow all-metal monoplane trainer It is believed that the Canadian company will undertake a substantial production program of the Harlow type trainer in connection with the Empire air training scheme now developing

$1,000,000 Ryan Backlog

Representing orders for exhaust manifold systems from three leading aircraft manufacturers, additional contracts received by the Ryan Aeronautical Company total more than $200,000, and bring Ryan unfilled orders to more than a million dollars, according to announcement of T. Claude Ryan, pres. With approximately $900,000 worth of Ryan aircraft on order production and deliveries are being maintained at the highest rate in the company's history, according to Ryan

Some Recent Awards

Navy Department

Douglas Aircraft Co., Inc., Santa Monica, Calif $28[illegible],324 for services and material for airplanes

War Department

Sharpsville Steel Fabricators, Inc Sharpsville Pa $84,783 for cylindrical tanks

Bendix Products Corp., South Bend Ind $84,449 for carburetor assemblies

General Electric Co, Schenectady NY $832,568 for supercharger assemblies

North American Aviation, Inc. Inglewood Calif $175,431 for maintenance parts for airplanes

United Aircraft Corp East Hartford Conn $91,720 for propeller assemblies and controls.

Goodyear Tire & Rubber Co, Akron $873,126 for wheel and brake assemblies

The B G Corp. New York City $11,412 for spark plugs.

The Ideal Electric & Mfg Co Mansfield Ohio, $57,902 for primary cubicles for night lighting installations

United Aircraft Corp East Hartford Conn $46,597 for maintenance parts for propellers.

The Ohio Seamless Tube Co, Shelby Ohio, $52,040 for steel tubing

American Gas Accumulator Co, Elizabeth NJ $62,318 for flood light lamp assembly

Fairchild Aerial Camera Corp, Jamaica, NY $518,349 for aircraft cameras

Aviation Mfg. Corp, Williamsport, Pa $173,593 for engines and spares

COL. JOHN H JOUETT, re-elected president of the Aeronautical Chamber of Commerce

Aero. C. of C. Officers

Col John H Jouett, who appeared during late February before the House Banking and Currency Committee in Washington to plead that the Export-Import Bank be left free to finance the shipment of commercial aircraft to foreign countries, was reelected president of the Aeronautical Chamber of Commerce at its annual meeting During the House hearings Col Jouett stated that great stimulus to American producers of commercial aircraft and engines would follow the Export-Import Bank's being given approval to handle commercial aircraft.

Other Aeronautical Chamber of Commerce officers to be elected were: vice presidents, J H Kindelberger, C C Moseley and Howard Mingos, secretary, Oliver L Parks, treasurer and assistant secretary, Frank J Walsh

Under the vigorous leadership of its officers, the Chamber has recently increased its activities about 40 per cent Work in each of the several departments has been vastly augmented

Consolidated Expands

Last December Consolidated Aircraft was sitting pretty, with a $20,000,000 backlog that promised to use the full capacity of the five-year old 25-acre plant at San Diego Then, at one blow,

the biggest single aircraft order ever placed by the government doubled Consolidated's backlog and threw a real production problem on their hands.

Now comes the announcement of an 87½ increase in factory space to provide the needed capacity An additional 64 acres have been leased or optioned, and 400,000 sq ft will be roofed New facilities will include final assembly, final finish, paint shop and wood mill, and experimental, maintenance, and office space Extra assembly space is also to be provided by paving yard areas, since well-known California climate permits outdoor work most of the year.

Under a closing agreement with the Treasury, part of the cost of expansion is to be charged against the government order.

Other Expansion: Other plans for expansion of the industry announced recently include the following:

Metallurgy Research: A new research laboratory for powder metallurgy is being set up in Yonkers by American Electro Metal Corp Lab will carry on research program now being pushed by Electro Metal's president, Paul Schwarzkopf.

Lubrication: Aro Equipment Co, auto lubricating equipment makers, have decided to break into the aircraft field with a line of automatic lubricating equipment. J. F Johnson of Pump Engineering Service Corp will have charge of the new line

Plastic Planes: Timm Aircraft Corp is now getting work going in its new plant for producing plastic airplanes The building was finished late last year, but they have been waiting for delivery of the big bake oven

Lockheed Cracks Africa

Sale in recent weeks of 25 Lockheed Lodestar transports to three different African airlines is not only one of the first concrete examples of displacement of German equipment which can no longer be serviced, but also appears to indicate a breakdown in the barriers which the British have been trying to put in the way of U S sales to the dominions.

News out of the Lockheed factory continues to make exciting reading as word is released simultaneously of substantial commercial and military orders including, on the one hand, a $20,000,000 order for 200 additional British bombers, and on the other hand orders for a total of more than twenty-five of the new fourteen-passenger Lodestar transports, and three of the new Excalibur four-engined transports for Pan-American Airways The British bomber order represents exercise of an option held in connection with previous work The Pan-American order is the biggest news of all as it puts Lockheed right up alongside Boeing and Douglas in development and manufacture of the big four-engine transports

Recognized as the first aircraft manufacturer to establish an apprentice training program approved by the Federal Committee on Apprenticeship, according to R. Randall Irwin, Lockheed Industrial Relations Manager, the Lockheed Aircraft Corp inaugurated its first class of 40 apprentices on Feb 1st, 1940.

New Consolidated

An official Army Air Corps release covering the new Consolidated XB-24 four-engine landplane bomber gives the plane a gross weight of 40,000 lbs, wing span 110 ft, length 64 ft., over-all height 19 ft, and with accomodations for a crew of six to nine men, depending on mission.

Performance estimates include a top speed of more than 300 miles per hour, range of approximately 3,000 miles, and bomb load capacity of about four tons The plane is powered by four Pratt & Whitney 18-cylinder twin-row engines of 1200 h.p each, and is propelled by Hamilton Standard 3-blade hydromatic constant speed propellers of 12 ft diameter.

The wing is of the Davis airfoil type with high aspect ratio and high mid-wing mounting on the fuselage. Construction is all-metal throughout, of stressed-skin design, with fabric covered control surfaces. Landing gear is of tricycle type, retractable Fowler type trailing edge flaps extend the length of the wing inboard of the ailerons Large bomb doors open in the belly and generous hatches and turrets are provided in nose, top, sides and rear of the fuselage

New Northrop Ships

Northrop Aircraft, Inc, has completed wind tunnel tests at California Institute of Technology on two advanced type aircraft, and an experimental test plane is now under construction. Test flights are planned within 90 days, probably late in the spring In connection with its research and experimental program the company is planning early construction of a tenfoot wind tunnel at the Hawthorne plant.

New Douglas Plant

A large assembly plant is to be erected on Los Angeles airport under terms of a lease recently negotiated between Douglas Aircraft Company and the city of Los Angeles. The lease covers ten acres of ground adjoining the airport runways, and provides for construction of an assembly plant and installation of machinery and equipment.

For Canadian Deliveries

To facilitate delivery of American aircraft purchased by the Canadian government, a modern airport is being constructed at Pembina, N D, by the Lockheed Aircraft Corp

San Diego Labor Demand

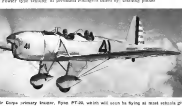
Aircraft plants in the San Diego area will be hiring about 3 000 factory employes during the coming year, on the basis of present backlogs This estimate was arrived at a meeting of personnel managers called by the Ryan School of Aeronautics in connection with initiation of a five-week course in sheet metal work. That there won't be any great difficulty in finding men to fill these jobs is indicated, however, by the fact that when Northrop opened its new Hawthorne plant it had on file more than 2,500 applications from workers with aircraft experience.

144 Vultee Vanguards

With work on its factory expansion program nearing completion, Vultee Aircraft, Inc., Downey, Calif, suddenly received a new order about three times as large as the Army trainer order for which the factory building program was undertaken The new deal is said to involve construction of 144 Vultee Vanguard pursuit planes for a total figure of about $9,000,000 Although reported ordered for the Swedish air force, there was a rumored three-cornered arrangement by which the planes would see service in Finland In any event the order is to be executed under pressure for early delivery The Vanguard, capable of better than 350 miles per hour, is said to be one of the fastest interceptor type aircraft now in production anywhere, has an extremely high rate of climb, and has many advantageous features from the standpoint of operation and maintenance.

Large Kinner Order

Canada has placed with Kinner Motors Inc, Glendale, Calif, the largest single engine order ever granted a Pacific Coast aircraft engine builder Calling for 509 aircraft engines of 125 h.p., the contract involves approximately $500,000 The Kinner engines will be placed in 404 Canadian-made Fleet primary training planes



Newest Air Corps primary trainer, Ryan PT-20, which will soon be flying at most schools giving initial flying instruction for the Army. Commercial designation for this ship is STM-2.

AVIATION ENGINEERING

Martin Flight Recorder

A system for simultaneously recording airspeed, altitude, air temperature, manifold pressure and engine speed for two or four engines has been developed by the Glenn L Martin Company for simplifying measurements that must be made during flight testing Nobody need tell the test flight engineer the advantages of such a device to help keep him from going cross-eyed trying to make the multitude of measurements that must be recorded during tests in a present day ship.

The coordination of these measurements was made possible through the use of several separate instruments One instrument, which records air speed, altitude, and free air temperature, was made from a standard 0-5 milliampere Esterline-Angus recording milliameter Outside air temperature is made by the meter directly, by the use of a temperature-sensitive electrolytic resistance cell, which may be mounted as far from the recorder as desired, and a simple switching device. The airspeed and altitude units were added to the top of the original meter case and are of the balanced diaphragm type, which eliminates the need for a sealed case. To reduce the chart-drag, fine-bore capillary pens are used which combine ruggedness and low hysteresis, adding to the accuracy of the instrument.

The airspeed unit covers the range of 50 to 250 m.p.h. in a 5-inch chart width, and the altitude unit from 30.5 to 11 inches of mercury pressure in the same chart width

Manifold pressure and engine r.p.m. of two engines are recorded on a modified Friez Flight Analyzer, incorporating four Autosyn motor units, each operating a single pen. Accurate coordination of all of the charts is accomplished through the use of push buttons which operate the marker pens.

TO TEST ALTITUDE EFFECT ON RADIO LOOPS United Air Lines high altitude test chamber was put through some new paces when their radio engineers decided to give a new plastic and standard shielded loop the works.

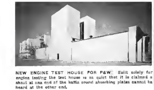
New P & W Test House

Built solely for the testing of engines the new Pratt & Whitney experimental engine test house was designed to give a straighter and less turbulent flow of air through the chambers and a greater reduction in noise than any of the previous test houses. In profile the structure looks like a huge white inverted T, 60 feet high, 172 feet wide and 54 feet deep

The four test chambers are situated at the corners of the new building and are divided, two on a side, by a lower level passageway that runs the width of the building These chambers are capable of testing engines up to 3,000 horsepower. On the second floor, directly over the lower level passageway, is the test house control room from which operators observe and control testing procedures

Each test chamber has a horizontal intake stack, instead of the previous vertical type, which draws air from outdoors into the chamber The stack contains vertical rows of soundproof baffles, spaced alternately one and two feet apart and consisting of three layers of sound-absorbing material retained within meshwork supported on steel frames.

Taller, longer, and narrower than the 1937 experimental test house, the new building cost $200,000, of which nearly $40,000 was for soundproofing



NEW ENGINE TEST HOUSE FOR P&W Built solely for engine testing the test house is so quiet that it is claimed a shout at one end of the baffle sound absorbing plates cannot be heard at the other end.

Lockheed Design Book

Representing a major contribution to transport plane design problems a 48-page illustrated booklet on "Wing Loading, Icing and Associated Aspects of Modern Transport Design" has been published by Lockheed Aircraft Corporation The work of Clarence L Johnson, Lockheed Chief Research Engineer, the book deals exhaustively with the related points of icing and high wing loading of transport planes. Based on extensive flight test work, wind tunnel research, and engineering calculations, the conclusion is reached that increased wing loading is desirable. Increased wing loadings are shown to give improved performance, range, and economy, without reduction in safety factor in landing condition The problem of icing is found to be no more severe on heavy than light wing loaded planes.

UAL'S Loop Tester

A new use has been found for the United Air Lines high altitude test chamber in testing a new type molded plastic shielded loop antenna. When the pressure in the altitude chamber reaches an equivalent of 55,000 feet the two loops, the other being a standard shielded loop, are plunged into a chamber of water by an electrically operated tripper. Then the "altitude" pressure in the chamber is reduced to sea level and the effect of moisture and humidity on the two loops is compared.

The high speed of the Republic EP-1 model 100 is 320 m.p.h. with a cruising speed of 290 m.p.h. instead of 330 m.p.h. and 240 m.p.h. as stated due to a typographical error on page 53 of the February, 1940 AVIATION.

On page 39 of the same issue the 1939 price of the Monocoupe ($4175) is given The 1940 price, however, is $5175

Weight Engineers' Soc.

Formed to promote recognition of the problems of aircraft weight control, the Society of Aeronautical Weight Engineers has organized in Los Angeles, with a membership of approximately 55 engineers, representing all major Southern California aircraft companies Officers elected for the 1940 term are L. R. Hackney, Lockheed Aircraft Corp, chairman, E. S. Fife, Vultee Aircraft, vice-chairman, and Mel Huber, Douglas Aircraft Company, Secty-Treas Meetings are held quarterly, the next regular meeting being set for March 15th

Helicopter Inventor Dies

Dr George DeBothezat, inventor of the helicopter and well known for his pioneer work in the field of aerodynamics, died in Boston on February 2nd following an operation He was 58 years of age. He came to the U. S. from Russia in 1920 and was employed as an aerodynamicist by NACA His first helicopter was built in 1923 for the Army Air Corps.

Trips For Springtime

Having got themselves the best of all talking points—a safety record—the airlines are getting ready for travel, augmented by restrictions on foreign travel, that will have no precedent in history. TWA has noted the first symptoms of spring and has put extra trips on Chicago-K.C. CCA has authorized reduced rates.

United Air Lines elected 23 New York air travelers members of the 100,000 Mile Club. Maximum salaries of stewardesses was raised from $135 to $145 per month. The minimum is $110, the rate for student stewardesses. United's revenue passenger milage this year is already 57 per cent over the beginning of last year.

Braniff Airways has assigned its fleet of 21-passenger Douglas Super-B Liners to its regular flight schedules.

It is reported that five airlines will place some 40 DC-4s in operation in 1940, and that one or more airlines will take delivery of about 30 Lockheed four-engined "Excaliburs" in 1941. The Douglas order will total about $14,000,000.

American Airlines will employ 80 new stewardesses to augment its present staff of about 163. A class of 33 has been signed and has started training in the Company's school at La Guardia Field. The course has been extended from six weeks to seven.

Northwest Airlines added three DC-3s to its fleet operating between Seattle and Chicago.

Col. Edgar S. Gorrell, president of the Air Transport Association, addressing its engineering and maintenance conference at Kansas City, commended the Civil Aeronautics Authority for its policy of minimum regulation, and said the industry could continue to write its own program if it will use foresight and pool experience for the good of all.

In the first month of service with its new Douglas planes Pennsylvania Central has an increase of 83.47% in passenger traffic over the same period last year.

Chicago and Southern will launch a big advertising campaign in March, April and May in a list of national and aviation magazines and radio stations.

Pan Am. Gets Certificate

Pan American Airways won its application for certificate on its San Francisco and Los Angeles to Hawaii to New Zealand route.

Company is getting set to help the United States grab South American business while Europe is fighting. Will speed up the Argentine run to four days. Will step up present trips on both Latin coasts from two to three per week. Build up capacity of present carrying lines by 50 per cent.

To begin this expansion the company has ordered for delivery beginning early in 1941, six Lockheed "Excalibur" 30-passenger, four-engined Transports which manufacturer says will be 30 m.p.h. faster than any similar planes, designed to cruise at 200 m.p.h. with three engines operating.

PAA has made application to CAA for route certificates on one-stop service—Los Angeles to Mexico City, connecting of course with all Latin lines. Application is made also for New Orleans direct across the Gulf to Guatemala. A heavy airport development program on these lines is nearing completion.

Next expansion will be 48 hours to Buenos Aires and another 50 per cent stepup in carrying capacity. PAA has to compete against the best equipment Europe can build, and against the Latins leaning toward old world trade.

Foreign competition in the South American field is creeping up on Pan American as regards speed of equipment. To keep ahead of the furriners drafting boards, PA has ordered three four-engined transports from Lockheed with a speed of 300 mph, and has options on three more.

The Gods, CAA and FDR

American Export's application for a certificate to fly the Atlantic to Southern Europe (Britain and France when the war ends) is in the laps of the gods, CAA and President Roosevelt. Both Pan American Airways, which opposed the application, and Export have summed up their arguments before the CAA examiner. Their briefs have been filed. Next, after weeks of study of the voluminous record, will come the examiner's opinion and decision. The decision will determine whether or not there is any American Export Airlines, and whether there is to be competition on the sea. Except that if the application is rejected, which now seems unlikely, a drive will be made in Congress to amend the CAA Act to make competition mandatory.

Maintenance Meeting

Over 300 men from all branches of the industry attended the Kansas City meeting of the Air Transport Assn's Engineering and Maintenance Conference on February 5–7. Col. Gorrell opened the meetings, and was followed by T. P. Wright, whose paper is reprinted in part in this issue. Clarence Johnson of Lockheed gave an excellent paper, "Wing Loading, Icing and Associated Aspects of Modern Transport Design." A. W. Dallas, CAA engineer, reported on the CAA and ATA experimental works in engine fire prevention and showed color movies.

Revise Wear-Out Rate

United Air Lines is revising depreciation rates on its 21-passenger DC3s and engines effective Jan. 1 last. The rates are extended from four to five years on planes, and from 4000 to 8000 hours on engines. It is estimated the revision will reduce the charge against 1940 income by about $163,736. The change will have no effect on 1939 profit, but there will be an upward adjustment of about $573,000 in Company's earned surplus through transfer from depreciation reserve. Experience shows that the equipment has a longer life than anticipated.

A training course in airline mechanics has been established at Company's Cheyenne overhaul base. A new $350,000 hangar and office building is to be erected at Mills Field by San Francisco and about 200 United personnel will move there from Oakland Airport, which, however, will continue on schedules and will keep the Boeing school.

Airline Forecast

A one third increase in passengers carried by domestic airlines in 1940 over 1939 figures is anticipated by CAA officials. CAA Chairman Robert H. Hinckley recently estimated that the passenger increase, plus 15 to 20 per cent increases in express and mail, should result in a 20 to 25 per cent increase in net revenues. This is on the basis of an estimated 10 per cent increase in operating expense.

Much of the credit for the expected increases is given to the new big ships the lines are purchasing, and much to the safety record of last year—only one fatality and none since March 26.

Pan American News

THE FLYING FORTIES WILL BE MARKED with plenty of big ships on the airlines. Fastest of these to date seems to be the Lockheed Excalibur ordered by Pan American. Carrying 30 people, ship will have range of 1500 miles at speeds up to 300 m.p.h.

U. A. L. OFFICIALS JOIN PENNSYLVANIA-CENTRAL in celebration of PCA's new Douglases. First ship flew United's airways from Los Angeles, stopping enroute for receptions. Picture shows plane at Chicago. L. to r.: N. B. Roder, UAL interline traffic mgr.; S. E. Gregg, UAL sales director; Capt. J. H. Carmichael, PCA operations mgr.; Harold Crary, United vice president; J. J. O'Donovan, PCA vice president; C. Bedell Monro, PCA president.

Moline Forced Landing

Preliminary evidence and opinion is that the report on United's Moline accident will show nothing new. The plane held altitude and performed all right for a long distance on one engine. Press statements to the contrary were based on misunderstanding. Safety Board's report probably will show, however, that after the pilot got the plane on or near the ground at Moline, and tried to circle for another attempt after deciding he had overshot, the single engine was not equal to the necessary climb. The ship was pretty well loaded, but less than capacity. It is said on good authority that the overshooting of the field was due to wind conditions on a runway other than the one on which the landing was to have been made. The cause of this change of plan was not known as this was written. Pilot Charles E. Wheeler has an excellent record. He was commended for skillful work by officials of the Company.

Airlines Fold Tents

Moving the Eastern mecca of all airlines from Newark to New York has got a lot of people into a peck of trouble. Newark has filed suit in U. S. Circuit Court against CAA, which authorized the move after extended hearings. Senator Warren Barbour (R.) of New Jersey has offered a resolution that CAA be investigated by Congress. Newark Airport has sued American Airlines for $131,000 rent contracted for. AA has filed a counter suit for $100,000 damages for nonperformance of contract by the airport.

Here's what observers say: New York passengers complained years ago about their terminus being in another state; Newark should have seen the move coming as inevitable. On the other hand, they say that LaGuardia and the New Deal and the Authority railroaded the decision to move. Much nonsense has been spouted on both sides. The upshot is that New York is entitled to have a terminus of its own. Probably Senator Barbour will get nowhere with his resolution. In a few years Newark airport will have more business than it ever had.

AIR TRANSPORT INDICATOR

February 1, 1940

160.90

Which is the ratio of passenger-miles reported by the Air Transport Association for all domestic lines for January, 1940 to the figure for January, 1939. Total for the Indicator has decreased slightly over the last month but still remains ahead of last year. For the first month of 1940 traffic stood at 55,441,672 revenue passenger miles—up 60.9 per cent.

See Finance page for individual companies.

AVIATION FINANCE

Order backlogs still rise faster than deliveries and prospects of further large war orders may cause new aircraft plant expansion meanwhile a steady stream of financing follows the successful Lockheed flotation and the industry is giving huge orders to machine tool accessory and sub-contracting companies

Brewster, Republic and Vultee have all received foreign orders which swell their backlogs to record size Unfilled orders of Brewster stand at $22,000,000, against $10,900,000 at the 1939 year-end; Republic has $15,200,000 against $11,-500,000; and Vultee $15,000,000 as compared with $9,300,000 on January 1 The large down payment which accompanied Brewster's large British order made unnecessary the financing reported under consideration awhile ago

Piper Aircraft financing entails the sale of around 30,000 common shares at about $8.75 a share Proceeds will be used to retire bank loans and for working capital Company expects to produce 2,500 planes in 1940, as compared with around 1,700 in 1939, and has a two and one half month backlog

Pan American Airways registered with SEC 525,391 capital shares, proceeds to be used for purchase of 6 Boeing clippers at $2,900,-000, 10 Douglas DC-3's at $1,-200,000, 3 Lockheed Excaliburs at $710,000, and 3 DC-4's for an amount not disclosed Bank loans will also be retired Stockholders received warrants to buy 5-14th of a share of new stock for each share held

Continental Motors has completed the final step in its financing with the public sale of 350,000 common shares Bids of $574,000 were received for the abandoned Detroit properties Unfilled orders last month totaled $6,494,000, the largest volume in years.

United Air Lines finds its equipment has longer life than expected and, in consequence, plans to reduce depreciation charges 20% on planes, and extend the depreciation period for engines from 4,000 to 6,000 hours This would cut 1940 charges against income nearly $195,000, and transfer $573,000 to earned surplus from the reserves of former years On this basis UAL will charge off most of its planes over a five year period instead of four as previously, in line with the policy followed by American Airlines TWA is reported giving consideration to a similar change

Mid-Continent Airlines will partly finance the purchase of three Lockheed Lodestar transports through an offering of 50,000 shares of stock at $4 a share Earnings for the 5 months to November 30, 1939 were $34,769 or 15¢ a share, as compared with a net loss of $95,229 in the year ended June 30, 1939.

Consolidated Aircraft is expanding its plant 92% to take care of a record $43,000,000 backlog In negotiation are said to be British and French orders which would bring the backlog up to around $50,000,000.

Among the aviation investment trust annual reports for 1939, National Aviation disclosed a net asset value of $17 27 a share, Air Investors $1 67 a common share, and Aviation Capital Inc $40 02 a share

Canadian Colonial Airways is understood to have operated in the black in 1939 In January 1940 this line flew 1,737,000 revenue passenger miles, as against 381,000 a year ago and carried 1,737 passengers, an increase of 228% A $350,000 stock issue is planned to provide additional working capital

Aviation Corp. has sold the marine and industrial business of its Lycoming subsidiary which henceforth will concentrate on aircraft production . . . Beech Aircraft's unfilled orders totaled $1,378,000 on February 1, up 29% from a year ago North American Aviation is working three shifts on a backlog of $51,000,000 Micromatic Hone has doubled its productive capacity within the last year, with 30% of its sales volume coming from the aviation industry . . . Vought Sikorsky division of United Aircraft has bookings extending well into 1941 Kollsman Instrument is operating at a high rate of capacity against a record bank of orders . . . Recent Lockheed stock financing was more than five times oversubscribed . . . Large plane manufacturer is completing negotiations with Goodyear Tire & Rubber for a quantity of metal and metal fabric airplane tail surfaces. . . . Taylorcraft delivered 490 planes in 1939, as compared with 366 in 1938 . . . Bullard Co. declared a 25¢ common stock first quarter dividend . . . Hayes Body will sell 275,000 common shares to secure funds for additional machinery to make aircraft parts . . . Briggs Mfg. Co. becomes more active in aviation industry through manufacture of an experimental plane for U S Navy . . . R Hoe & Co is now making parts for three large aircraft manufacturers . . . Thompson Products' aircraft division is operating at capacity and reported to be heavily booked throughout this year . . . Porterfield's backlog is said to total 175 planes.

With the Airlines

Company	Revenue Passenger Miles January 1940*	1939*	% Gain	12 months 1939*	1938*	% Gain	Revenue Passengers January 1940	1939	% Gain	12 Months 1939	1938	% Gain	Revenue Miles 12 Months 1939*	Express Lb 12 Months 1939*	Earnings before taxes 12 Months
American	17 721	10 710	90	207 350	140 860	47	45 939	25 032	83	541 757	3s8 295	31	a 17 220	a 2 41	a 81 820 103
Boston & Maine				2 411	2 257	24	1 427	985	51	16 375			733	262	d 11 551
Braniff	1 858	1 229	50	18 413	13 354	38	3 665	2 754	48	33 353	29 323	50	3 308	286	79 143
Chicago & Southern	660	441	50	9 244	6 820	34	23 300	16 622	41			41	1 788	116	82 240
Continental				2 152	1 320	63				8 854			947	10	52 456
Delta				7 852	5 940	32				20 301			1 580	62	92 105
Eastern	11 387	7 041	40	102 904	71 386	44	21 000	14 000	50	280 243	162 246	73	e 9 863	a 666	a 815 125
Inland				2 272	1 140	99				8 757			1 008	24	13 985
Mid Continent	230	170	60	4 134	3 379	24	1 173	700	48	18 584	11 678	42	1 174	56	35 429
National	333			2 143	728	190	1 400			9 835			718	21	23 487
Northwest	2 464	1 315	47	34 749	21 153	64	5 207	2 891	97	74 510	46 323	60	5 151	415	232 283
Penn Central	1 829	1 013	60	21 193	15 079	35	10 499	5 717	83	122 383	85 484	43	a 3 163	526	a 131 226
T W A	9 923	4 208	84	99 621	71 775	39				a 181 079	a 110 563		12 038	809	a, d 192 177
United	6 651	6,137	57	186 034	108 873	37				a 262 135	a 201 866		18 171	2 167	a 086 738
Western Air				11 090	10 540	04				30 907	25 004	20	a 2 078	301	90 225

* Last three figures omitted (a) 11 months (d) Deficit — All Current figures subject to final adjustment

Current Earnings Reports

Company	Period	Net Income 1938	1939	Common share earnings 1938	1939	Sales 1938	1939	Back log Current	1939
Air Associates	3 months Dec 31	$83 925	$5 444	$0 50	$0 01	$717 750		$1 300 000	
Bell Aircraft	Year Dec. 31	9 203	65 488	0 03	0 33	450 438		7,400 000	$3 700 000
Bendix Aviation*	Year Dec 31	4 500 000	156 000	2 15	0 07	40 000 000			
Lockheed*	Year Dec 31	3 140 000	442 111	4 85	0 87	35 303 000	$10 274 000	$1 000 000	33 000 000
Pan American Airways	9 months Sept. 30	1 011 256		0 03					
Ryan Aeronautical	11 months Nov 30	76 277	23 602	0 20				1 480 000	300 000
Taylorcraft Aviation	Year Dec. 31	26 488	346	0 15	0 01	727 310	495 970	38 880	17 208

* Preliminary

PROFIT & LOSS

A Billion Dollar Year in 1941

By Raymond Hoadley

Mr Hoadley would be very glad to answer inquiries regarding the financial outlook of the listed aviation companies

This country hasn't seen anything yet in aircraft output to equal the production job which plane and engine makers are planning for the next two years Aircraft sales this year will total around $750,000 000 and prospects are that the industry will have its first billion-dollar-year in 1941 Orders on hand indicate that 1940 production will rise three times the sales of 1939, if the industry achieves the delivery schedules now planned Impending Allied orders, larger than those already received, would allow the industry to pass the billion dollar mark another year It is too early to gauge 1940 profit prospects for this busiest of American industries, but, if bottlenecks and production problems are solved in time to escape foreign contract penalty clauses, the record 1939 profits will be easily outdistanced And industries engaged primarily in other lines will have their earning power "suped" up through aircraft plant expansion, raw material demands and sub-contracting One of the largest aircraft engine producers already draws materials from 14 states and pays to outside companies more than 50% of its manufacturing sales dollar The aviation industry will be an important factor in keeping business humming amid the uncertainties of a Presidential year

With activity in aviation stocks totaling nearly 10 per cent of all stock exchange sales, Wall Street shows more interest in this industry than ever before and has definite opinions regarding its future Some fear aircraft makers are in for a long period of intense deflation after the war Others predict that "the sky is the limit" for this stock group The larger, more moderate group take middle ground and are impressed by the opportunity suddenly presented to this industry They are guided, perhaps, by the World War experience of the motor companies During that war the auto manufacturers gained their great export markets (which they still keep) and, for the first time, earned sufficient profits to conduct research, develop mass production and reduce prices The experience of the aircraft industry in this war may be somewhat similar Enjoying a commanding position in the commercial field, the industry is making a more energetic drive than ever before to develop that supremacy, war orders will come in without much effort. Belligerents will have only uneconomical converted bombers to sell for commercial use when peace comes Meanwhile neutrals everywhere are being schooled and tooled for American equipment and will look our way for quality aircraft for years to come Secretary Morgenthau sized up the situation recently when he observed that all the world wants American aircraft. And he denied that current aircraft plane expansion will fall on American taxpayers or investors, pointing out that the cost is borne by foreign money

It appears unlikely that aircraft stocks will sell at high price-times-earnings ratios . . . war flavored issues seldom do . . . but they should give a favorable account of themselves as 1940–41 prospects turn into tangible results. Profits of the manufacturers should rise in proportion to sales Higher costs of labor and materials can be largely offset by improved production methods An early peace appears less likely since Russia came in And the outlook was never better in the private flying and transport fields.

The old joke about the castored investor who bought Seaboard Air Line for an air transport stock has been revived in the financial district since a New York daily pointed to the rising volume on this railroad as an example of increasing air traffic

AVIATION OPERATORS CORNER

Master Airport Plan

Outlining a $20,000,000 master airport plan for Los Angeles County, the County Regional Planning Commission has submitted a report to the Los Angeles County Board of Supervisors which covers proposed improvements to the county's existing 22 airports, and recommends construction of nineteen new fields to provide the county with an ultimate total of 41. This plan is based on a projected need to house and care for operation of 10,000 planes within the county by the year 1960. The plan outlined includes about $5,000,000 for purchase of land and $15,000,000 for improvements, many of which would be provided with Federal funds. Two major seaplane bases are provided for in the project.

Here Here Miami

Miami is going to have a super-colossal airport, and if all its eight runways on sixteen points of the compass were laid end-to-end nobody who reads the press release would be surprised. They're that excited. More paved runway space than any other field on earth! Total 33,600 ft.! More than the mighty Templehof! Each one 8,000 ft. long—"The longest ever conceived by airport engineers." (Come, come, Miami, we've conceived a runway from here to Hollywood.) Note: It will cost only $1,155,725 because of natural advantages in that fabulous land.

Piper Sales Double

Maybe its the CAA's training program, maybe the country's getting airminded—anyway, its certainly not the war that has more than doubled Piper Aircraft Corp.'s 1939 sales as compared with 1938. Last year Piper announces 1,806 Cubs, ranging in price from under $1,000 to $1,995, were sold. Sales in 1938 totaled 737. Reflecting this active business, employment at the Lockhaven, Pa. plant rose from 300 last January to 525 the beginning of this year.

Upcurrent For Gliders

CAA has been teaching a lot of young fellows that you have to bank when you want to turn, and it's certain that they—and their kid brothers—are going to want to get off the ground now and then when the course is over. But hourly rental on even the lightest airplanes looks pretty big to most youngsters.

Conclusion that a lot of men with a little money to invest are drawing is that there should be a market for sailplanes. Latest move to get manufacture of the motorless ships out of the backyard stage was organization in Los Angeles recently of Bowlus Sailplanes, Inc. The new organization has hired William H. Bowlus as engineer, and bought the patents of the former Bowlus Co. The San Fernando factory is being enlarged, and it is planned to turn out fifteen sailplanes a month in knock-down kit form.

As noted last month, Schweizer Aircraft has reorganized and is building a bigger plant, and a new propaganda organization, Junior Airmen of America, has started pushing gliding.

Edward T. Keenan of Frostproof, Florida is the nation's only soil doctor who flies to his appointments. A specialist in soil chemistry and plant diseases he uses a Fairchild 24 as both a means of transportation and a flying laboratory.

Ericksen & Remmert of Floyd Bennett Field are kept busy giving Link Trainer instruction these days. Here Ken Behr, field manager (left) congratulates Capt. Juan Montenegro of the Cuban Naval Air Force on the completion of a tough flight problem. At right, Instructor E. L. Ericksen.

Aero Club of Kentucky announces its second Annual Aircraft Exhibit at Bowman Field, Louisville on May 11 and 12.

Allegheny County Airport at Pittsburgh has a new manager, J. T. Brooks, whose work to attract more private fliers to the field has resulted in bringing in a branch of Graham Aviation, operators at Pittsburgh-Butler Airport. Graham now offers complete service at both fields, as well as a seaplane base in downtown Pittsburgh.

Lots of activity is going on at Florida's airports. At Daytona Beach extended runways are being built and old runways are being paved. Seaplane floats have been dedicated at Tampa, St. Cloud and Jacksonville. Bartow has leased its field to Channing Baker who plans extensive improvements. T. P. Martin is the new field manager at Melbourne and is starting work on new gas tanks, hangar and field repairs. Work on the Ft. Meyers airport will start this month. Tallahassee has appointed a new aviation committee to recommend field improvements.

Clarence Ludwig has bought the Tampa Flying Service and employed Clarence Snyder to run it. Charles Hoenes, former owner, is now a copilot with National Air Lines. Col. Russel West, just back from China, has opened a new flying school at Knight airport in Tampa.

Go West, young man, if you want to be healthy. Or so the Air Corps finds in recruiting for its pilot training program. In the country as a whole, only 20 to 25 per cent of those applying for training pass the physical exam. But in the Pacific Northwest, examiners find, 52 per cent pass.

During the first six months of the new training plan three classes completed primary stage training. Last July 1 the system began of assigning twelve weeks of preliminary training to nine private air schools, twelve weeks intermediate training to Randolph Field, and advanced training to Kelly Field.

Of 1,181 students who started primary training with the three classes, 759 or 64 per cent got to Randolph Field. Of the 257 in the first class which reached Randolph Field, 60 per cent went on to the advanced training at Kelly Field.

Students completing the course, receive a commission in the Reserve or, in a few cases, in the regular army.

REPORT CARD

Of Air School

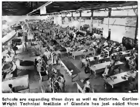
With thousands of new men needed for Southern California aircraft factories, the aviation schools of that section have been hard pressed to provide enough skilled men. Every school and factory has cooperated to make the expansion process as orderly as possible. At Lockheed an extensive employee training program is in full swing. In San Diego, where Consolidated Aircraft Corporation is currently doubling its factory facilities and both Solar and Ryan are hiring steadily, the vocational schools of the city have taken a hand in the training program, offering six-week courses designed to teach aircraft shop fundamentals to 2000 young men by July 1st. Ryan School of Aeronautics has expanded its course to include a six-week mechanic course, and has inaugurated a number of new training programs, including a course for parachute riggers.

In the vicinity of Los Angeles substantial expansions of school facilities have been undertaken by Aero I.T.I., California Flyers, Curtiss-Wright Technical Institute, and others. The problem has been complicated by the influx of large numbers of Canadians who are undergoing forced-draft training. Curtiss-Wright has taken over an additional 35,000 sq. ft. of floor space and now has more than 1,000 men under instruction, including about 300 enlisted Army men, and 45 Canadians. The school has recently provided a new engine-test building providing for simultaneous testing of ten engines. The Army flight training program, also handled by Moseley, has been given a permanent operating base on a 4000 by 2700 ft. field near Newhall, after having been forced off three successive fields through complaints of property owners. Aero I.T.I. is running on a two-shift basis in spite of recent completion of two large new school buildings. Robert Noorduyn, president of Noorduyn Aviation Co., Ltd., Montreal, recently visited the school to study facilities for training Canadian workers needed in the expanding Noorduyn factory. He found 82 Canadians already under instruction.

Even in the correspondence school field the expansion program has had its effect. Gordon Brown, president of Westwood Correspondence School, Los Angeles, has announced the appointment of Walter Webb as industrial coordinator, to cooperate with aircraft factory executives. Westwood has also added new quarters for classroom instruction purposes in Inglewood, to accommodate increasing enrollments from among present factory employees seeking to better themselves.

Roosevelt Aviation School graduated its first class of Air Corps mechanics at the end of January. W. D. Guthrie presented diplomas to 22 men who immediately left for their home station at Mitchell Field. Classes are now being graduated every two weeks.

New equipment at the Rising Sun School of Aeronautics includes five controllable pitch propellers, a propeller balancing stand, and several engines, including a 550 hp. Wasp. Students are completely rebuilding a Vought that was purchased.



Schools are expanding these days as well as factories. Curtiss-Wright Technical Institute of Glendale has just added these 35,000 square feet of space to accommodate more students.

TAGGING THE BASES

with LES NEVILLE

Industry Leaders Get Behind Soaring

It seemed like old times to hear about Ray Cooper rushing around directing the recent glider party of the Southern California Soaring Association. We remember the days when Ray was the directing genius for many an air show or meet and it's good to see him back at his old trade again. But there is additional significance in the roster of stockholders of Bowlus Sailplanes, Inc., of which Ray is vice-president and general manager. (See p. 101) When you find major aircraft manufacturers, air line presidents, and leading school and airport operators investing their cold cash in a sailplane company, you can be assured that these men are looking at the industry in its true perspective and are pausing in the turmoil of forced draft production to lay the groundwork for the peace-time industry of tomorrow.

We picked up a Washington newspaper the other night and what jumped out of the page but the beaming face of Al Bennett. It later developed that Al has caught on fast to the Washington technique and he had been haunting the halls of Congress with the story of his flight training plan. Marching closely on his heels was a press photographer he had brought along just in case he was needed. This is the type of public relations sense that a lot of fixed base operators could use. Al is doing a swell job of selling aviation to the public. If he is as successful in his work on Congress as he has been in selling Cub airplanes, the prospects for the Bennett plan should be very favorable.

Pilots are good cooks according to a recent report from the northwest. It seems six of the local boys got tired of the Y.M.C.A. and rented a six room modern home in Aberdeen, S. D., and our informant assures us that all is spic and span. Only female assistance is a housewoker who does the laundry and changes the beds. The fellows take turns at the cooking. The novice experimenters are "Only" Lytle, Clarence Ablin, Harold Christensen, Fred Dosch, Martin Closter, and Arnold Patterson. They say they don't save any money but they have a home. Homeless pilots might do well to follow their example.

Hadley Field is looking for greater industrial activity and has invited manufacturers to consider its advantages including location with respect to New York City and facilities for water craft manufacturing and railroad connections. Many acres of land bordering the airport are available.

Two excellent papers on fire prevention and fueling have just been summarized by the Aero Insurance Underwriters and contain much valuable information, "Handling Aviation Gasoline at Airports" a bulletin of the Aero Chamber of Commerce, and "Notes on Fueling Aircraft," by E. E. Aldrin. The material is boiled down into simple form and could be given directly to mechanics and other workers for their instruction.

A new hangar costing about $60,000 will be built this spring at Kansas City's Municipal Airport. The field has been so busy that additional space is needed. An addition to the present office building of TWA is also to be built by the City, which will be rented to the airline. A new underpass beneath the Burlington tracks on the east side of the field will improve the east entrance to the airport. If even half of the new airline routes which are being asked for are approved by CAA, Kansas City will need even additional facilities to take care of the boom in transport business that is sure to arrive in the near future.

California Soaring Party

Southern California Soaring Assn. held a successful gliding party in late January at the Malibu ranch of movie director Clarence Brown. Twenty-one pilots turned in over 60 flights with 12 sailplanes, most of them tow-offs with the Buxton power winch. Since Albert C. Essig, aviation advertising counsellor, organized Bowlus Sailplanes, Inc., and secured backing of many big names in aviation, soaring has received great stimulus, especially in California. Bowlus general manager is Major Ray Cooper. The Soaring Assn. plans several additional meets soon.

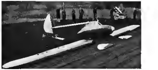
ROSS mid wing takes the air on a winch tow.

THREE men who helped put over the show. l to r: Jack O'Meara, pilot; Albert C. Essig, Bowlus organizer, and Major Ray Cooper.

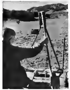
HOST Clarence Brown chats with Hawley Bowlus before a flight.

PILOTS came with their sailplanes from as far as Salt Lake City.

SHORT WAVE kept winch in touch with take off. l to r: Max Archer; W. G. Briegleb, glider mfgr.; Jack Ludewitz, pilot.



A BOWLUS secondary sailplane disassembled to show ingenious method for taking plane apart for transportation purposes.



JAY BUXTON, inventor of the practical winch that was used.

Right: PARTIAL line-up of ships

The Airacobra

(Continued from page 41)

axis of the fuselage sets +5° to the ground when at rest, and the length of stroke in the front and rear elements of the landing gear are adjusted so that at 90 m p h take-off speed the angle of attack is increased to provide lift equal to the gross weight of the airplane When landing at 75 m p h along the path of glide, the front and rear wheels contact the ground at the same instant

The general construction of the P-39 airplane follows the present practice of all metal, stressed skin design, but it is noteworthy to point out a few of the detail refinements that have been incorporated in this airplane.

The fuselage structure is comprised of two sections: (1) a forward section extending from the nose to the bulkhead aft of the engine, mounting the reduction gear box and extension drive shaft, landing gear nose wheel, armament, cockpit and engine and incorporating the wing center section and (2) an aft section extending from behind the engine to the tail. The two sections of the fuselage are bolted together in a manner to permit rapid disassembly for shipment or repair. The forward fuselage section consists principally of two main longitudinal beams, with a horizontal top deck between, upon which the installed equipment is mounted, much in the manner it would set on a platform. The fuselage covering above the longitudinal beams is almost entirely cowling, which when removed, provides an unprecedented degree of accessibility that is further emphasized by the decentralization of the power plant, armament, cockpit and radio equipment The wing affords an excellent platform for working on the engine The structure of the P-39 airplane has been completely static tested to 100 per cent of the design loadings, which are the latest requirements of the U S Army Air Corps

The wings of the P-39 airplane are of the cantilever type of all-metal construction throughout The internal ribs and bulkheads are stamped or pressed metal Fuel tanks providing for storage of more than 150 gallons of fuel are built integrally into the wings. Ducts of the type developed by the N A C A, extending from the leading edge of the wing to the upper surface of the wing near the trailing edge are built into the root of the outer wing panels, providing cooling air flow for the prestone and oil radiators The rear elements of the tricycle landing gear retract, completely flush, into the outer wing panels, aft of the main spar structure The airfoil sections are: at the root the N A C A 0015 section and at the tip the N A C.A 23009 section modified A very successful feature of design of the wing is the alignment of the axis of symmetry of the symmetrical after body of the N A C A 23009 airfoil with the chord line of the N A.C.A 0015 section used at the root to produce a simplified symmetrical wing structure for manufacturing purposes, with an effective degree of aerodynamic twist, or "wash in" at the tip which avoids the common fault of early "tip-stalling" so prevalent in many low wing monoplanes

Split trailing edge wing flaps are provided on each outer wing panel, extending from the inboard end of the ailerons to the fuselage. A feature of the flap design is the proportioning of the span, chord and angular deflection of the flaps, so that the effective downwash angle of air flow on the tail surfaces is increased when the flaps are deflected to a degree where the change in trim of the airplane is negligible from stabilized level flight, at cruising power, flaps up, to a stabilized glide, power off, at approximately 100 m p h providing a perfectly co-ordinated trimming condition for the landing approach The relatively low wing loading and the relatively large and effective wing flaps make the stalling speed less than 70 m p h which, together with the tricycle landing gear and the delayed stalling character of the wing tips and lateral control system, provides maximum safety and facility for landing, even under adverse conditions or by pilots of limited experience, an important feature in military aircraft.

The ailerons are constructed of metal with a doped fabric covering, and are of the balanced slotted type. A trim tab is provided on each aileron, controlled from the cockpit. A feature of the aileron design and aileron control system is the combination of a venturi shaped slot with a rounded modified friese type nose balance actuated by a differential link motion in the control system. This provides slotted aileron function to maintain lateral control at the stalling point of the wing It also provides a variation in the slot, from wide open at zero angular deflection to full closed in the extreme "up" and "down" positions, to provide sensitive, effective control and feel for small displacements of the ailerons and reduced operating loads for large angular deflections of the ailerons. The arrangement of the aileron slot and slot entrance radii is also such that the effectiveness of the slot varies with the angle of attack to permit relatively large airflow through the slot at high angles of attack and almost no airflow at low angles of attack, a circumstance that gives a more uniform control force throughout the speed range with minimum drag at high speed The lateral control system of the P-39 airplane provides a maximum of good handling characteristics and safe lateral control at low speeds

The tail surfaces are of the full cantilever type, with the fixed control surfaces of all metal construction and the movable surfaces consisting of a metal frame with fabric covering Trim tabs are provided on each movable surface, controlled from the cockpit. The radio antenna mast is enclosed in a transparent plastic leading edge on the vertical fin, which eliminates the drag or the hazard of ice formation on the conventional external radio mast. Anti-icing boots can be installed over the transparent leading edge without affecting the radio function

The two-way radio and storage battery are located in the aft section of the fuselage The radio is operated by remote control from the pilot's cockpit

The external surfaces of the P-39 airplane have been specially treated to reduce skin friction drag to a minimum and act as camouflage. Flush rivets are used all over and a thin coating of special filler followed by a coat of primer and two coats of special aluminized lacquer are applied as a finish. The finished surface has a dull texture that is aerodynamically smooth, but practically non-reflecting. The dull finish and clouded grey color form effective camouflage.

Specifications and performance supplied by the manufacturer follow:

Wing span	34 ft.
Overall length	29 ft. 9 in.
Overall height	9 ft. 3 in.
Wing area	213 sq ft.
Wing loading	28.3 lb./sq ft.
Power loading	5 3 lb./b.h p
Empty weight, approximately 5 000 lb	
Useful load, approximately 1 550 lb	
Gross weight, approximately 6,000 lb	
Maximum speed, around 400 mph	
Cruising speed, approximately 325 mph	
Service ceiling, above 36,000 ft.	

British Aces

(Continued from page 29)

had a waiting list since before the outbreak of war. Qualifications are high, though they have been relaxed somewhat from peace-time standards. Now public school graduation is sufficient educational qualification for entrance to the air force, with high school or college graduation required for a flying berth in the R C A F.

Under the British Commonwealth Air Training Plan few officers will be graduated, though a number will be selected for commissions on graduation. All trainees will start as aircraftsmen, class two, the equivalent of an army private, with pay of $1 30 a day. On completion of their training they will be ranked as non-commissioned officers, with pilots and observers being ranked as sergeants at $2.20 a day.

The first training is a ground course to prepare the recruits for flying and for air force life in general. This is given in three large schools, takes four weeks, after which a selection is made of those who are to be trained as pilots, gunners or observers. Pilots are then sent to one or other of Canada's 22 light airplane clubs for an eight week elementary flying schooling. After eight hours of dual flying instruction, the recruit is forced to demonstrate his ability and to indicate whether he has developed the required air sense to warrant further training. On completion of 20 hours of dual and solo flying, the recruit is expected to show a higher degree of skill in his tests. The final examination comes after 50 hours in the air and includes medium and steep turns, forced landings, sideslipping and aerobatics. From there the recruit goes to the intermediate and advanced training schools.

For the next fourteen weeks the pilots receive training in intermediate and advanced flying, bombing and fighting, at one or other of 16 service flying schools. During this period trainees from other Empire countries join the Canadian airmen at their training schools.

Air observers receive a 12 weeks course at 10 air observer training schools, where they are taught navigation, reconnaissance and photography. On graduation they go for six weeks to one of 10 schools where they are taught bombing and gunnery in theory and practice. The air observers are ready for the battle zones after another four weeks of advanced navigation taught at two air navigation schools.

To train these fighting airmen Canada is busy developing an army of 40 000 officers and men. It is officially estimated that when the training scheme is in full working order it will need 2,700 officers, 30,000 airmen and 6,000 civilians for instruction and maintenance. Latest official figures for the strength of the Royal Canadian Air Force show 1,500 officers and 15,000 men. Many instructors in advanced training arrived in Canada from Great Britain early this year. In all 67 training schools are in use for the plan, and when Premier Mackenzie King announced the plan in December he stated that in addition to present air force, flying club and government-owned Trans-Canada Airlines fields available, 60 more airfields, still to be built, would be needed. Barracks have been and are being built to house the thousands of trainees.

The total cost is officially estimated for the three year period under which the plan operates, till March 31, 1943, at $600,000,000. Canada's share is to be $350,000,000. Great Britain will supply most of the airplanes, New Zealand and Australia will contribute cash and men.

Six types of aircraft have been designated for use at the training schools to standardize as much as possible the training. Elementary training is being done in Fleet Trainers and de Havilland Tiger Moths. At the intermediate training schools Avro Ansons and North American Harvard trainers are being used. Bombing and gunnery schools are using Fairey Battle aircraft. At wireless schools the Noorduyn Norseman is standard. Early in January it was officially announced that 1,282 training aircraft were being built in Canada, that 870 Fairey Battle two-seat medium bombers were to be shipped to Canada from Great Britain, that 1,622 Avro Anson airframes were being shipped to Canada from Great Britain for assembly in the Dominion where wings are also being built, that North American Harvard training planes were to be manufactured in Canada as well as bought in the United States. The Noorduyn Norseman is being made in Canada.

The Fleet Trainer, de Havilland Tiger Moth and North American Harvard are two-seater single engine light training planes. The Avro Anson is a twin-engined coastal reconnaissance monoplane carrying a

(Turn to page 117)

Personnel Relations

(Continued from page 33)

the L.E.R.C. canteen which dispensea foodstuffs, soft drinks, tobacco, and other merchandise. The company constructed a modern canteen building and turned it over to the employees to operate. The enterprise is now earning a net profit of approximately $1,000 per month. This the L.E.R.C. devotes to recreational activities and to assisting employees who are in financial need.

Another self-supporting activity of the L.E.R.C. is a monthly magazine known as the "Lockheed Aircraftsman" which carries non-controversial news of employee and company activities. The publication is supported entirely by local advertising.

To coordinate employee-management relations and to maintain uniform personnel policies in all departments, we have established an industrial relations, or personnel department. The primary functions of the industrial relations manager are to keep abreast of labor laws and regulations, advise management on labor relations policies, deal with the union officials, handle grievances and discipline and coordinate the policies and work of the three major divisions of the department, i.e., Employment, Employee Service, and Education.

The principal function of the employment division, that of selecting new employees, was treated extensively in the first article of this series. In addition, the division is the clearing house for all transfers, promotions, periodic employee ratings, wage and salary increases, and terminations. Before any change is effected in an employee's status, his entire record is reviewed by the employment division, and additional tests are often administerod as an aid in arriving at a decision. Through such careful consideration of each change, favoritism and discrimination in promotions and wage increases are reduced to a minimum.

Through the employee service division the company maintains its close cooperation with the L.E.R.C. and conducts a broad program for serving the personal needs of the employees. Although employees who are in trouble usually come to the division head voluntarily, there are occasions when an employee is approached and urged to "unload" his problem. This is done when some outside influence obviously is interfering with his work, or when a garnishment or threat of attachment of wages is received. Advice or legal aid is offered when an employee's case needs such service. Each situation is handled upon a basis of the urgency of the need. Sometimes an employee must be warned to "get his own house in order" so that his personal affairs will not interfere with his work or relations with the company.

To meet emergencies, a cash fund, administered by the employee service division, extends prompt aid in event of accident, death or other pressing necessities among employees and their families.

Through a group plan, employees may participate in life, health, and accident, accidental death and dismemberment, medical reimbursement, and surgical and hospitalization insurance. The insurance section, in addition to handling group insurance, supervises workmen's compensation insurance problems, in conjunction with the medical section of the employee service division.

Staffed by competent doctors, first aid attendants and a visiting nurse, the medical section conducts periodic physical examinations, gives medical advice and treats industrial injuries. A visiting nurse follows the progress of every employee on a prolonged illness or accident disability.

Other functions of this division are safety inspection and education, and the maintenance of a housing service. Rentals are listed and advice is provided on home financing and construction.

An important phase of the company's counseling program is conducted through the education division, which, because of the acute shortage of competent workmen, was established under the direction of Svend Pedersen, former chief tool designer of the company. Based upon the results of temperament, intelligence, and aptitude tests, the staff of this division is able to assist each employee in finding the vocation in which he is apt to achieve the greatest degree of success. Provisions have been made whereby the employee may continue his training so that through self-improvement he will be ready for promotion to higher positions. Through the cooperation of the State Department of Education, Lockheed has been instrumental in the establishment in the Burbank School System of a wide range of trade extension classes covering a field from mechanical preparatory work to advanced engineering subjects. The response is so enthusiastic that nearly one-third of all Lockheed employees attend these classes regularly. Current enrollment is approximately 2,000 students.

To provide a supply of semi-skilled workmen, during periods of excelerated production, the education division conducts a full-time class to train new employees in the fundamentals of certain production jobs. During the first five months of 1939 nearly 2,000 employees were given from two days to three weeks of full-time training in this class. A new employee must demonstrate in the class his ability to perform acceptable work before he is put on production.

Because of its experience in trade extension and job training work, Lockheed recently was able to respond promptly to a plea by President Roosevelt that aircraft manufacturers establish apprenticeship training programs in order that this country's aircraft industry will be able to meet any national emergency. Within a few weeks after this call the Lockheed company and the local union had drafted and signed an apprenticeship agreement with the cooperation of the Federal Committee on Apprenticeship. The program provides for four years of training in any one of several trades.

Other phases of the educational program include the maintenance of a library, development and administration of trade tests, as well as the sponsorship of foremanship and supervisory training.

In working with supervisors the industrial relations department has been careful not to assume any of the responsibilities that rightfully belong to them. Rather, we have impressed them with the fact that the development of a comprehensive personnel program adds to, rather than detracts from, their responsibilities. The various divisions of the industrial relations department are strictly service units which relieve supervisors of many details that would take their attention away from their primary functions of developing and producing airplanes.

Much of the credit for success of the industrial relations department in coordinating its work with that of production departments of the factory is due to placing of the department under the direct supervision of Mr. R. A. VonHake, vice president and works manager, who has been most sympathetic towards the development of the industrial relations department. Under less happy supervision it is possible that the system as outlined above would not function so well.

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Outwitting the Wind

(Continued from page 35)

85 m p h in the direction shown by the arrow, he would never intercept the leg, but would drift approximately parallel to it indefinitely as shown at C If, however, he did succeed in crossing the leg, then turned to a heading perpendicular to the A average bisector, he would drift back across the leg, as shown at D, thus proving that he was on the northwest leg which would give him a false orientation An instance occurred in flight, in which this failure of the 90-degree problem two consecutive times, caused a pilot to land 300 miles off his intended course.

Other difficulties in radio range orientation and in procedure flying have been discovered by means of the wind simulator. The procedure turn shown in Fig 2 without wind at A, when done with a wind of three-quarters of the air speed or more, will result in a figure as shown at B, in which the object of the procedure turn is completely lost because the flight path does not return to the leg Many other difficulties and weaknesses of the old instrument navigation methods have been discovered at TWA and the methods have been revised to correct these difficulties and to render our methods adequate in winds of the highest velocity, regardless of whether the pilot knows their direction or velocity or not

The teaching of dead reckoning on instruments is greatly facilitated by the wind simulator, for this provides an accurate check on the correctness of the pilot's computations. If the pilot be told correctly the direction and velocity of the wind, and allowed to compute the heading and time necessary to fly a given geometric figure or from point to point on a chart, the accuracy with which he completes this figure or flight, is a measure of the correctness of his computations

In Fig 3 is shown the effect of a wind of 65 m p h and a true air speed of 120 m.p.h. on a square Note the drift downwind In order to teach dead reckoning, the pilot may be required to fly this square correctly, despite the wind which causes him to drift An interesting example of the the effect of wind on a flight is shown in Fig 4 In this illustration, the pilot made a continuous, left-hand, standard, one needle-width's turn, as shown by the dotted line. However, he continually drifted downwind, describing the path shown in the figure

Fig 5 shows the effect of a 65 m p h wind, on a 120 m p h air speed, when the pilot is flying the inverted U problem commonly used in Link Trainer instruction Note that at no time is the pilot east of his starting point.

Associated with the wind simulator is a loop direction finder simulator. This device provides means for accurately simulating the use of the loop direction finder in aircraft navigation. It is completely automatic in operation and by it, all of the problems commonly done with loop direction finders may be accomplished and taught The pilot may be taught to take bearings on stations, may home into station in the ordinary way, either keeping his ship headed on the null or by flying constant courses and setting the drift off as automatically applied by the wind simulator, thus flying a straight course into the station. He may also take bearings on two or more stations and plot his position by means of the customary two or three bearing fix

A new use for the direction finder just worked out is that of determining one's position and heading without recourse to the magnetic heading of the airplane. This solution would be necessary in case of failure of the magnetic compass By means of direction finder bearings on three stations, a fix may be accurately and quickly determined, and from this the heading of the airplane determined and the directional gyro set correctly This problem is easily taught in the Link Trainer by means of the loop direction finder simulator, and the wind simulator

C-W Maintenance

(Continued from page 37)

Wright heater unit operates independently of the main power plant, operates equally well on the ground or in the air, heats the cabin quickly, maintains cabin temperatures on the ground without the aid of outside sources of heat even in the coldest weather, and thus eliminates the customary cold-weather bug-a-boo Since this system involves no steam lines, the customary ground freezing problem in cold weather is likewise eliminated.

The cold weather troubles that plague air line ground crews have been eliminated in the new transport, wherever economically possible. The traditional wobble pump, heretofore used with difficulty in obtaining fuel pressure during cold starts, has been replaced by an electric fuel pump which assures adequate, controlled fuel pressure for starting and supplements, of course, the usual engine-driven fuel pumps Another development in the fuel system is the location of all fuel tanks in the wing outer panels where the dihedral gives a natural slope to the tanks, assuring positive drainage at all times, complete drainage of water to the large cast aluminum alloy sump at the lower end of each tank, and elimination of the possibility of water remaining in the tanks with consequent damage from corrosion.

Since time-saving is unquestionably the essence of air line maintenance economy, our development of the new Curtiss-Wright "Tell-Tale" system for automatically checking and indicating any malfunctioning of the major controls or instruments of the new transport provides the maintenance department with a new and valuable tool. While the operating advantages of this system have been described many times and are fairly well understood, the servicing benefits are not so well known.

It is obvious however that a device which instantaneously checks on the correct operation of every engine and air control, and on the operation of the complete power plant under various conditions, provides the maintenance crews with a rapid bird's eye view of its problems Questions that formerly required hours to answer may now be checked in a minute or two.

Our engineering staff has worked hard to achieve a new peak in maintenance perfection; they have concentrated on providing accessibility, removability, interchangeability and simplicity on the one hand and to providing local strength and rigidity at every point on the other; they have sought to speed servicing by eliminating parts where many parts would complicate maintenance and by adding equipment which would short-circuit involved routines.

The final result, affirmed by the results obtained during the preliminary test period of the new Curtiss-Wright Substratosphere Transport, I believe is an airliner which will not only be valued by the air transport operator because of its Profit-Ability but will also merit of the praise of the maintenance departments because of its Maintain-Ability.

Transport Trends

(Continued from page 112)

Graphs (B) and (C) of Fig. II show increases in horsepower and cost of equipment. Twin-engined landplanes costing $115,000 may be expected to increase to over $225,000 and 4-engined ships in the $350,000 bracket will be with us soon. In the flying boat field we are now in the half-million dollar class. Graph (D) shows the steady increase in average seating capacity, rising from 7 in 1932 to 14 at the present time.

Airplane characteristics are shown in the four graphs in Fig. III. Cruising speed, it will be observed, has roughly increased in ten years from 100 to 200 m.p.h. A rather slight flattening-out tendency is now evident although there will be a substantial lapse of time before the limit for certain classes of equipment is reached.

Noteworthy in graph (B) is the flattening-out of the wing loading trend curve for landplanes at a figure just under 35 lb./Sq.Ft. It is likely that seaplane loading will continue upward although both may be further increased (than is shown by these curves) as the result of introduction of assisted take-off means. Power loadings have not decreased greatly and will probably stabilize at about their present figure.

In connection with landing speeds, the flattening-out tendency of the curve is indicated, but it should be mentioned that in general it can be shown that for equal safety, landing speeds can legitimately increase proportionately to the sixth root of the gross weight. The graph shows curve for the largest size of equipment. Landing speeds will be less for smaller planes.

In graph (D) the jumps in cruising altitude represent for the most part changes in the powerplant which permitted economical flight at successively higher altitudes. Equipment just about to make its appearance will raise the present level to 20,000 feet and it is my belief that eventually 35,000 feet will be utilized for certain classes of equipment and service.

Not only have airplanes increased in size and speed, but they have become a great deal more comfortable and far safer. The air traveler these days is getting a great deal for his travel dollar. Graph IV (A) is extremely important, in that the steady increase in weight per passenger of passenger furnishings and safety equipment has been so marked in the past ten years that the operator now carries the equivalent weight of two passengers and baggage for every one that he actually carries! Passenger furnishings now weigh 175 pounds per passenger, with safety equipment at about 15 pounds. The old Fords carried about 25 pounds per passenger of such furnishings. Because of the increase in passenger equipment it has not been possible to increase the useful load of the airplane in terms of percentage of gross load. In fact, an actual decrease has occurred. From 1929 to the present this percentage has decreased from 40 to 33 where it appears to be stabilized. For flying boats during the same period it decreased from 45 to 42.

Provision for increased space in flying boats, as shown in (B) is a substantial contribution to passenger comfort. One-half of these values apply to landplanes. From the passenger's viewpoint, however, (C) shows the greatest contribution: noise reduction. The decible unit (old scale) is used and it is seen that from the days of the Ford in which noise of 110 decibles existed, we are now in the 70 decible range. This 40 per cent decrease is based on the decibel unit which, in turn, is a logarithmic scale measurement. The actual sound in today's air liners is but 1/50,000ths as much as ten years ago! It is almost exactly the same as for Pullman cars and far less than in street cars and subway trains and only slightly more than for an automobile traveling at 50 m.p.h.

And now for safety. In Fig. IV (D) are shown the actual points which have been maintained during the past ten years for passenger fatalities per 100,000,000 miles flown, and a trend curve. The record is remarkable and important. In 1939 travel on scheduled air lines was so safe that, comparatively speaking, a passenger could fly from the West Coast to the East Coast every day for 100 years before his number would come up!

Unstinted credit for this remarkable safety record is due airline operators for the infinite number of self-imposed regulations earnestly carried out which brought about this fine condition. Substantial contributions have also been made by our plane and engine designers. A few of these are

Table II

AIRPLANE CRUISING SPEEDS

Factors causing Increases of the Past Ten Years and Possibilities of the Next Ten Years

Item	Description of the Item in Detail and Improvements Involved	Speed Improvement Actual 1929-1939	Speed Improvement Possibilities 1939-1949
"Wasted Drag"	Streamline shape, smooth surfaces, interferences, improved nacelles, elimination unnecessarily exposed parts, improved Reynolds Number accompanying size increase.	% 36	% 9
Wing Loading	Improved flaps and sections	17	4
Power Loading	Increased allowable landing speed with size increase, higher takeoff powers with improved fuels.	8	0
Altitude Flying	Progressively from sea level to 10,000 feet to 35,000 feet.	9	18
Wing Efficiency	By more perfect taper, thinner and improved sections, etc.	7	2
Induced Drag	By higher aspect ratios, elliptical wings, etc.	1	2
Propeller	Operation at better V/ND, blade section improvement.	1	2
Structural	Weight Reductions due larger size, better materials, and improved design	1	3
		80	40
Resultant Cruising Speeds	Average Values typical of the period.	105 to 190 MPH	190 to 266 MPH

Notes. Further but more remote possibilities are —
Cooling drag reductions or elimination
Very high wing loadings using Assisted Takeoff,
Greater than normal powerplant improvements,
Complete laminar flow by section change combined with small chord or boundary layer control

(Continued from page 115)

the use of multi-engined equipment having satisfactory flying qualities under all conditions of flight; general improvement in stability and controllability; improvement in power-plant reliability; perfecting of the constant speed and full-feathering propeller; tremendous developments in instrumentation, use of de-icing equipment; and current efforts to reduce or eliminate pilot fatigue by making the pilot's job easier and his working conditions more comfortable. The important advances in meteorology, radio communication and airway traffic control should also be stressed.

Future Performance

In Table 2 are shown the factors which made possible the 80 per cent increase in cruising speeds which occurred from 1929 to 1939. The preponderant effect of aerodynamic cleanness shown in the first item is noteworthy, with the additional substantial items of increased wing loading, decreased power loading, flying at higher altitudes, and wing efficiency, following with minor improvements in the last three items in the table.

My prognostication of increases in cruising speed to 266 m.p.h. in the next ten years will be effected by the same items but with a different relative proportion for each as shown in the second column of the table. The importance played by flying at still higher altitudes should be noted together with important improvements in drag reduction, although of only one-quarter the magnitude that maintained for the last ten years.

The reason for this is shown in Table 3 where it will be observed that horsepower "wasted" in overcoming unnecessary drag is now but 20 per cent of the total as against 66 per cent ten years ago. At that time speeds made good were only 65 per cent of what they would have been if all this unnecessary drag were eliminated. The proportion of actual speed to streamline speed is now 90 per cent.

Airplane range will be increased about 30 per cent in the next ten years by three factors: speed increases automatically bring improved range and such improvement may be in the order of 15 per cent, reduction in specific fuel consumption will bring a ten per cent improvement, and structural weight reduction should bring a five per cent improvement.

It should be noted that all of the speed increase shown in Table 2 will not go into range increase since that proportion attained by flying at high altitudes will not result in range improvement and, as well, the weight reductions resulting from structural improvements can not all be used both for speed and range increase. Then, too, cruising velocities are higher then schedule speeds which are reduced by time losses in take off and landing to give what are known as block-to-block speeds. As these losses are constant regardless of cruising speed, the final range increase due to cruising speed improvement is about 15 per cent as shown.

Transport aviation may be said to have had its infancy to 1911, its romantic childhood to 1926, its painful adolescence to 1931, its satisfactory progressing young manhood to the present time, and gives great promise for maturity for the future.

Table III
TEN YEARS ADVANCE IN AERODYNAMIC CLEANNESS

Year	Wasted* Horse power	Actual** Speed in % of Streamline Speed
1929	66	65
1939	20	90

* Wasted h.p. is h.p. consumed in overcoming the drag of unnecessarily exposed parts or of non-streamlined shapes.
** Streamlined speed is speed the airplane would make at a given altitude if its only drag were smooth, flat plate skin friction, drag caused by efficient cooling of the engine, and induced drag due to lift. Figures are obtained by using method of B. Melvill Jones.

One cannot but be inspired by contemplating some of the following:

A recent TWA timetable schedule headed, "Europe—New York—Chicago—Los Angeles—San Francisco—Asia."

The growth of one of the U. S. air systems, American Airlines, from its first passenger in April, 1927, to its millionth in February, 1937, and its two millionth in September, 1939.

The fact that our domestic airlines are now flying over 250,000 plane miles each day, the equivalent of 80 round trips from New York to Los Angeles, or of ten trips around the world at the Equator, or perhaps better still, one to the Moon!

The fact that there are 30 large airliners flying daily each way on scheduled trips between New York and Chicago.

And the fact that we are now enjoying regular coast-to-coast service in just under 17 hours which we may expect will be reduced to 12, and regular trans-Atlantic trips of 24 hours duration which will be cut eventually to 18.

These factors are all indicative of the inspiring future of air transport.

British Aces

(Continued from page 107)

crew of three to man five positions, the navigator in action becoming the bomb-aimer in the nose of the plane, and the wireless officer manning a Lewis gun in a revolving rear turret. The Fairey Battle is a two-seat medium bomber with a rear gunner's hinged transparent station from which is permitted free and sheltered use of the rear gun. The Noorduyn Norseman is a single engined transport monoplane which can seat in addition to a crew of three, five or six students in radio communication, or can be used as a troop ship carrying nine men with full equipment.

"The undertaking is one of great magnitude," to quote Premier W. L. M. King, when he announced the training plan on December 18, 1939. "It will establish Canada as one of the greatest air training centers in the world."

Vibration

(Continued from page 39)

three directions is individually adjustable, so that corresponding resonant frequencies may be shifted independently of each other. Dynamic suspension, the Stitz mount, and the flat plate sandwich type are good examples.

As mentioned above, it is often necessary to make adjustments in the mounting of power plants after completion of the airplane. Correction of a deficiency involves 3 steps:

(1) Determination of the existing resonance conditions
(2) Comparison with exciting forces
(3) Alteration in power plant suspension.

Determination of existing resonances is accomplished in a relatively simple ground test. An eccentric weight is attached through a bearing to the propeller hub and rotated by means of a variable-speed motor and flexible shaft. The weight is rotated at speeds from 200 to about 3600 RPM. An unbalance of 2 inch pounds is sufficient excitation to produce visible motion at most resonance points in this range, so that they are easily discernable. A correction is then applied to these resonant frequencies to take account of

Vibration

(*Continued from page 117*)

the stiffening effect that the gyroscopic action of the rotating parts of the power plant has on the whole assembly, and the result is compared with a table of operating speeds After alteration of the mount system, the test is repeated to show what has been accomplished.

Figure 3 (see AVIATION, *Jan. 1940*, pg 41) is a chart of a typical case, giving the gyroscopic correction and a list of resonances derived, with a comparison with the operating ranges The speeds at which parts of the structure and the accessories vibrate may also be listed Results shown on the chart are usually supplemented by a flight test

By way of explanation, it will be well to state that coincidence of an operating range and a rough point or resonance point as indicated by the chart is not necessarily an indication that severe vibration will take place. This results from the fact that the point of application of a vibrating force greatly influences the effect it has For example, the engine unbalance in a single row engine which produces an oscillating force close to the plane of the center of gravity, would not be expected to cause severe vibration *around* the center of gravity In a twin row, however, the unbalance forces occur in opposite directions, producing a couple or dynamic unbalance Thus in one type of engine mount the single row engine may be rougher, and in another type of mount the twin row engine will cause more vibration

In such a flexible system as an airplane, any change in the vibration of the power plant usually has a considerable effect upon that felt inside the cockpit and cabin Through use of the proper mounting device on the engine, additional vibration reducing means may be dispensed with in many cases Unfortunately, it is not always possible to provide the optimum conditions in this respect at the engine, and it thus often becomes necessary to use individual shock mounts for radio equipment, instruments, control panels, passenger chairs and tables, and the like

The common fault in the majority of installations is to make them too rigid, in which case the amplitude of the shock mounted object may actually be greater than that of the structure which supports it (Fig 4)

There is a very simple relation (Fig 6) between the natural frequency of a shock-mounted object and its deflection on the shock mounts due to its own weight, which is useful in determining what type of suspension should be used Figure 7 gives the reduction obtainable for a given ratio of resonant frequency to forcing frequency for the condition of no damping in the mounts, which is approximated in the usual types of shock mount at frequencies far from resonance. Use of these charts involves four simple steps

(1) Determine or estimate the lowest driving frequency for which isolation is desired, and the amount of reduction required. A reduction of at least 5 to 1 must be effected in order to cause any considerable improvement
(2) From Figure 7, find the necessary resonant frequency to obtain the required reduction
(3) From Figure 6, find the static deflection necessary to give the resonant frequency found in step (2).
(4) Choose a mounting device having the load-deflection characteristics specified in step (3).

An example will serve to clarify the use of these charts Suppose we have a radio weighing 10 pounds, which we wish to insulate from a strong vibration at 25 cycles per second The amplitude reduction must be 15 to 1 The natural frequency of the radio on its shock mount must then be 6½ cycles/sec (from Fig 7) and the corresponding static deflection from Figure 6 is .25 inch The initial rate of the shock mounts must then be approximately 40#/inch, and any undamped device having that rate will give the 15 to 1 reduction at 25 cycles/sec.

The primary objection to the use of sufficiently flexible shock mounts has been excessive deflection under high load factors or in the presence of intermittent vibration of very low frequency We may correct this deficiency by designing mountings in such a way that the deflection characteristic is moderately linear through the normally used range, but rises rapidly as the deflection increases further A simple way of accomplishing the same purpose is to provide a rubber bumper on any standard spring suspension, to limit the motion to a fixed maximum

While damping may normally be neglected in the design of shock mounts, it may be a very useful or a harmful quantity and its effects should be understood The curves of Figure 4 are given for a definite amount of damping, Figure 5 has the same sort of curves for various amounts. It will be noted that damping reduces the amplitude at resonance, but increases it at higher frequencies This curve applies to all simple vibrating systems, and may therefore be useful not only in design of shock mounts but also in reducing the vibration of fixed or semi-rigid parts for which shock mounting is not desirable.

Damping for these purposes may be applied in a number of ways. In an ordinary shock mounting device we may make use of rubbing between dry plates or felt, or if it is constructed of rubber the necessary resistance can often be incorporated in that material. Pitot tube and antenna masts are very effectively treated by mounting them flexibly in such a way that when the mast moves, its extension inside the wing or fuselage rubs against a pad of felt or similar material Damping is often extremely useful in treatment of bulkheads and panels that vibrate excessively, and in this case it is normally applied as a coating or blanket, directly to the sheet. Paints, felts, and certain solid materials have been used successfully.

Stiffening by reinforcement is often resorted to when parts begin to disintegrate unaccountably, and as we may see by examining the possible reasons for failure, it may be the wrong thing to do as often as the right If the affected parts are actually resonant, and are vibrating sympathetically with the engines or some other driving force, stiffening correctly applied may well serve to move them out of the resonant range. On the other hand, it may be seen from Figure 4 that decreasing the stiffness serves the same purpose, and damping may be a simpler remedy. If, however, the part is actually being forced to deflect with a fixed amplitude, a reinforcement will usually increase the unit fiber stress and cause failure to occur more rapidly. This is particularly true when there are discontinuities in the stressed part, as when a reinforcing member carries across only part of it and causes a concentration of stress to occur at its points of attachment. Fillets, gussets, and cowl sheets have often fallen into such a situation As a general rule, excessive amplitude in main structural members is caused by resonance; that occurring in nonstructural parts or in auxiliary structure is forced and should not be stiffened A vibration test on the ground will usually indicate what condition exists

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1940 I. Ae. S. Meeting

(Continued from page 43)

can be obtained with less horsepower if dual-rotation propellers are used to replace a single-rotation propeller with the same total number of blades. Paraphrased, any given horsepower will effect higher velocity under the above propeller replacement conditions The percentage gain in performance will increase with increasing forward velocity when dual-rotation propellers are used

Mechanically Driven Superchargers

By Richard S. Buck

Fifteen years ago, a supercharger used as standard equipment on an aircraft engine was considered a novelty, and, when used, it was mainly for the purpose of obtaining better fuel distribution and overcoming the losses in the induction system During the last ten years the performance of aircraft engines has increased tremendously The increased use of the supercharger was inevitable in obtaining higher performance at altitude. However, the improvements in the octane value of fuels and the developments in engine cooling have permitted large increases in specific performance by means of supercharger boost . .

The conventional aircraft engine supercharger consists of an entrance passage, an impeller, a diffuser, a discharge collector, and means for driving the impeller

The design of the supercharger entrance passage is very important, since poor design at this point may ruin an otherwise efficient supercharger. .

The impeller entrance passage should accomplish two things, deliver air to the impeller entrance with a minimum pressure loss, and distribute the air (and fuel if any) evenly over this impeller entrance . .

The simplest way of determining a suitable design of inlet passage is by model testing This may be accomplished by building models of the inlet passage, and connecting a blower to the model entrance The exit of the model is then that portion of the supercharger passage in the plane of the impeller entrance . . .

It has been found that impeller tip speed often has a marked effect on supercharger efficiency Since the speed of sound varies directly as the square root of the absolute temperature, it is reasonable to expect that the injection of fuel into the air before it enters the supercharger and also a lowering of temperature due to increased altitude will lower the critical speed This must be borne in mind if the superchargers are tested without the injection of fuel into the air upstream of the impeller. . .

There are two major problems involved in the development of mechanically driven superchargers; first the problem of building a machine which will be as efficient as possible, and second the problem of making this machine fit the operating characteristics of the engine

The design of a supercharger requires a thorough knowledge of what happens through each part of the supercharger itself and this knowledge can only be obtained by previous research test. Supercharging development is handicapped by a general lack of information regarding the characteristics of internal combustion engines when operating at high altitude.

Brittle Lacquers as an Aid to Stress Analysis

By A. V. de Forest and Greer Ellis

The fracturing of brittle coatings has long been recognized as an experimental method of checking strain distribution. Flaking of brittle mill scale at the yield point of local areas was used in the testing of the first wrought-iron bridges More recently brittle resin coatings, which will fracture within the elastic range of most materials have been developed to give good qualitative pictures of strain distributions . .

The primary role of stress analysis is to check a design for the distribution of the forces being carried In many cases a number of alternative designs are available and the best or the cheapest is to be selected To aid in this check, loads, simulating service conditions, are often applied to the structure and strains measured over the critical areas . .

A broad definition of a brittle coating is one which will fracture in response to strain in the structure beneath it Brittle oxide scale cracks and flakes in an irregular pattern when the metal beneath it yields It indicates areas of high local strains . .

While the brittle coating is unaffected by compression strains as such, nevertheless it is possible to evaluate them by causing the coating to fracture from the relaxation of a compression strain The procedure is to place an elastic structure under maximum load and then form the brittle coating on its surface At the same time a calibration strip is loaded, with its coated surface under compression, in the calibrator The test is run by relaxing the loads from their maximums on both the calibration strip and the structure in a manner very similar to the evaluation of tensile strains by the addition of loads.

Control Devices for Boundary Layers

By E. A. Stalker
University of Michigan

There is about every body immersed in a moving fluid a thin layer of retarded particles called the boundary layer To it can be charged more than one-half of the accidents in airplane operation, chiefly because the phenomena in this layer causes loss of lateral control

If the boundary layer is at the basis of numberable airplane accidents, upon it the attack should be concentrated The cure for stalls and spins lies in controlling the boundary layer and even if no other advantage accrued than that of adequate lateral control the result would be worth the cost . . .

It is not, of course, possible to relieve the air of its viscosity but possibly something equivalent to that might be done and so restore the hope of achieving the promise of the inviscid fluids, which is a maximum lift coefficient some six times higher than that of a plain wing . . .

Energizing the boundary layer by blowing is more expensive of energy than removing the layer by suction Where blowing is employed it is best to use a number of slots with a large volume flow at low pressure. . . .

Blowing slots are particularly satisfactory for lateral control for then the reaction from the discharged air counteracts the added drag from the added lift . . .

The need for efficient blowers for boundary layer control suggests a study of existing machines in the light of modern fluid and, in particular, of boundary layer theory One is immediately struck with the crudeness of most blowing machinery, at least for moderate pressures Centrifugal blowers of this type have almost no streamline parts but are composed in many instances of angle irons and flat plates Even the impeller is often so constructed. The designers, of course, are not unaware of this crudity and justify it on the basis of first cost.

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Bird

1930 BIRD, 100 h.p. Kinner. 45 hrs since major. Ship in perfect condition. Price \$1200. Leech Aircraft, Inc., Roosevelt Field, Mineola, N. Y.

B 5 BIRD for all around use, will take car or light plane in trade. R. Boyer, 1600 Sawmill Run, Pittsburgh 10, Penna. (T)

Cessna

CESSNA 1936. Engine just majored, total time 400 hours. Special instruments, sensitive altimeter, rate of climb, turn and bank. Price \$3000. Standard Aerial Surveys, Inc., 54 Park Place, Newark, N. J.

CESSNA 165 Warner Super Scarab engine. RCA Radio receiver. Approximately 100 hours new engine guarantee. Bargain. Warner Aircraft Corp., Detroit, Mich.

Cub

1939 4 5 place ... CUB J4A Continental 65 H.P., dual ignition. New September 1939, one owner, \$1500.00. A. S. Widstrom, Bound Brook, N. J. (T)

Curtiss Fledgling

CURTISS FLEDGLING Challenger 185 hp. 30 hours since major. Licensed July 1940. Excellent condition. \$425.00. Volgenau, 15 Orchard Place, Buffalo, N. Y.

Dart

DART A-3 condition. Less than 100 hours on motor. Private owned. Always hangared. Price \$2850.00. W. F. Hemler, Monroe, La.

DART Ken Royce 90, new Jan. 1939, 240 hours. Cream trimmed in green. Western Electric two way radio. Rate of climb, bank and turn, starter, generator, wheel pants. Privately owned, never cracked, like new, cost \$4228. Radio installation \$1000 additional. Will sacrifice for cash. Owner buying larger plane, make offer. Decatur Aviation Co., Decatur, Illinois.

Fairchild

FAIRCHILD 71A with Wasp C. Total on plane and engine since new—890 hours. Frank Ambrose, Whitestone Ave., N. Y.

FAIRCHILD Late 1936 Ranger 100 hours since factory rebuild. Landing lights, flares, new radio. Condition excellent. \$2800. R. A. Cooley, 15 Forest Ave., Buffalo, N. Y.

1936 Ranger FAIRCHILD. Wings just recovered, fuselage repainted, ship relicensed. Bank and turn, rate of climb, generator. 243 hrs since major. Price \$2360. Leech Aircraft, Inc., Roosevelt Field, Mineola, N. Y.

Excellent 1936 DeLuxe FAIRCHILD privately owned, never damaged. Instruments, Flaps, Wheel pants, Radio, parachute seats and other extras. Ranger motor 50 Hrs. since major. Total time 537 Hrs. Price \$3750. Campbell Air Service, Moline, Ill.

INDEX

AVIATION "Classified"—March, 1940

Undisplayed ads offering only ONE make of plane are grouped under that make. Others appear under "USED PLANES—General" and are numbered and indexed to enable readers to conveniently locate the make of plane offered, or other items of interest. All other undisplayed and displayed ads—excepting those relating to employment and business opportunities—are numbered or referred to by number, and indexed for the reader's convenience in quickly finding ads.

Used Planes

Funk

ATTENTION, Nebraska and Iowa flyers: See the new Funk 75. An all weather 2 S plane at light plane cost at Omaha. Ford distributor, Jack's Aircraft Sales, South Omaha, Nebraska.

Sikorsky

S 39 C SIKORSKY 400 Pratt & Whitney Junior installed Pratt & Whitney factory September 1938. Total time 342 hours. Ship majored September 1938 by Aero Trades. Generator P & W Junior Electric tachometer, electric gas gauges, bank and turn, rate of climb, one straightaway and one ball compass. Ship a general condition excellent. \$7,000.00. Henry J. Topping, Jr., 598 Madison Avenue, New York.

Standard

NEW STANDARD D25 Trainer, just majored throughout at cost of \$435.00. Relicensed till Nov. 1940. Price \$800.00. Will take car in trade. Beckley Air Transport Inc., Beckley, W. Va. (T)

Stearman

STEARMAN HAMMOND—all metal tricycle safety plane. Brakes, flaps, lights, battery, generator, self starter, stabilizer, instruments. Simplest plane to fly, has no rudders. Perfect condition. Cost \$7150. Selling for \$3200. Write Dr. S. Weiss, Bridgeport, Penna.

Stinson

1936 STINSON SR8-E Wright 320 two way radio, gyro. Complete set of instruments, etc. 750 hrs total time, never cracked, privately owned, excellent condition. Asking price \$6500, make any offer. Box 237, Leominster, Mass.

STINSON SR9B 245 Lycoming, just majored. Two way radio. Landing lights, flares. All blind flying instruments. 5 place. Hamilton Controllable. Fully equipped. Many extras. Yellow, black trim. 70 gallons. Reasonable. Quick sale. Wm. VanAvery, Box 332, Gloversville, N. Y.

STINSON 105 Demonstrator. 450 hours. Full polish finish. Bonding, Shielding, Antenna, Parking Brakes, Pants, Carpet, made highest cash offer. No trades. Box 358, Winston-Salem, N. C.

Waco

WACO STANDARD. Latest '37 225 Jacobs. Total time 200 hours. 160 hours since complete motor overhaul at factory. New type nose case, radio, landing light, flares, bank and turn, rate of climb, new propeller. Sacrifice. FS 560 Aviation, 330 West 42nd St., New York City.

Used Planes—General

(See index on page opposite)
(See also Group Classifications)

CUBS. Many bargains. Coupes 50 and 65hp \$1,450 up fully equipped. 50 hp Trainers, Franklin, Lycomings \$595. Exceptional buys, 1939 40 hp Trainers \$695 all relicensed. Kinner Standard relicensed \$750. Monocoupe, fine condition, relicensed \$425. All financeable. Don't delay! Write immediately. Bennett Air Service, Hightstown (Cranbury), New Jersey. No. 1

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